ENERGY SAVINGS OPPORTUNITY SURVEY
FORT A. P. HILL, VIRGINIA

A/E CONTRACT NO.
DACA 31-89-C-0198

PREFINAL SUBMITTAL

VOLUME III
APPENDICES

Prepared for

DEPARTMENT OF THE ARMY
BALTIMORE DISTRICT CORPS OF ENGINEERS
BALTIMORE, MARYLAND

By
ENGINEERING APPLICATIONS CONSULTANTS, P.C.
9004-B CROWNWOOD COURT
BURKE, VIRGINIA 22015-1679

April 1994

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DEPARTMENT OF THE ARMY
BALTIMORE DISTRICT, U.S. ARMY CORPS OF ENGINEERS
P.O. BOX 1715
BALTIMORE, MD 21203-1715

REPLY TO
ATTENTION OF

August 18, 1992

Engineering Division
Design Branch

Mr. Virender Puri
President
Engineering Applications
Consultants
9004-B Crownwood Court
Burke, Virginia 20215-1630

Dear Mr. Puri:

This is in reference to your meeting with Mr. James Hawk, Project Manager for this office, on August 3, 1992, concerning the Energy Savings Opportunity Survey, at Fort McNair, Washington DC; Fort Belvoir, Virginia and DeWitt Army Hospital Fort Belvoir, Virginia Contract No. DACA31-89-C-0198. As a result of this meeting, our letter of July 22, 1992 is modified as follows:

a. The Engineering study performed under contract DACA65-81-C-0021 was reviewed in detail. The Energy Engineering Analysis Program (EEAP) Final Project Energy Conservation Opportunities (ECO's) at AP Hill, Virginia shall be reviewed, updated and site adapted to Fort Belvoir, Virginia for implementation in FY 95. Site adapting shall be by extrapolating the energy savings calculated for AP Hill by the use of the degree day method. Included in the site adapting will be the ECIP analysis for ECO's for 11 buildings. No programming documents are required for Fort Belvoir. The updated energy saving data will provide the Government a reference base for future energy contracts. ~~Updating existing ECO's at AP Hill will be accomplished by escalating energy and construction costs associated with each ECO.~~ The A-E shall perform the limited surveying of 11 buildings: 101, 126, 214, 179, 311, 1528, 313, 1290, 179, 820, and 821 to determine if any of the previous recommended ECO's have been implemented. After surveying these buildings, and it is determined that the building modifications will affect the synergistic energy savings, the A-E shall notify the contracting officer within 30 days after the notice to proceed.

b. Automatic control systems for heat pumps to avoid the use of electric heat element as a primary source of heat will be analyzed. A-E shall calculate the existing energy usage of building types or classes by computer modeling. A total of 3 computer models shall be required. Three types of building types; masonry, frame, and metal skin shall be computer modeled.

c. The engineering study will require the AE to evaluate all buildings that have been constructed since completion of the original energy study. They will be included in the updated programming documents for funding as either PECIP, ECIP or QUIP programs. The A-E will perform field surveys of approximately 12 new buildings that have been constructed since the engineering study DACA-65-81-C-0021 was completed.

d. Building not designated for a full survey shall be included in the programming documents as similar to the ones surveyed. Sketches, equipment identification and any other information needed to complete the programming documents in determining energy savings will be require under this contract.

(1) ENGINEERING STUDY: Prepare an engineering study as per the requirements outlined in Contract DACA31-89-C-0198.

(2) GOVERNMENT RESPONSIBILITY:

(a) Provide access to the surveyed buildings at reasonable hours.

(b) Make maintenance personnel and agency representative available for discussion.

(c) Provide drawings of the buildings required for survey.

(d) Provide building energy consumption log, fuel rates and maintenance costs for buildings surveyed.

(e) The Commanding Officer at each installation will designate an individual who will serve as the point of contact for obtaining information and assisting in establishing contacts with the proper individuals and organizations as necessary to accomplish the work required under this contract.

(f) Coordinate existing building numbers with those designated under contract DACA-65-81-C-0021. The coordination study shall identify all buildings that have been demolished and constructed since the completion of the energy study.

(g) Provide A-E with list of buildings that have heat pumps as source of heating and air conditioning.

Information required in items (f) and (g) shall be provided within 21 days after the notice to proceed. If you have any questions concerning the above understandings, please call Mr. Hawk at 410-962-3774.

Sincerely,

Stanley N. Block, P.E.
Acting Chief, Design Branch
Engineering Division

SCOPE OF WORK
FOR AN
ENERGY SAVINGS OPPORTUNITY SURVEY (ESOS)

ENERGY ENGINEERING ANALYSIS PROGRAM

Fort McNair, Washington, DC

Fort Myer, VA

Fort Belvoir, VA

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1. <u>BRIEF DESCRIPTION OF WORK</u>. The Architect-Engineer (AE) shall:

1.1 Review for general information the previously completed Energy Engineering Analysis Program (EEAP) study and any other energy studies which were performed at this installation.

1.2 Reevaluate selected projects and energy conservation opportunities (ECOs) from the previous studies to determine their economic feasibility based on revised criteria, current site conditions and technical applicability.

1.3 Evaluate selected ECOs to determine their energy savings potential and economic feasibility.

1.4 Perform a limited site survey of selected buildings ~~as~~ as detailed in Annexes A1, A2, & A3 [illegible] to insure that any specific methods of energy conservation which are practical and have not been evaluated in any previous energy study have been considered and the results documented.

1.5 Provide complete programming or implementation documentation for all recommended ECOs.

1.6 Prepare a comprehensive report to document the work performed, the results and the recommendations.

2. <u>GENERAL</u>

2.1 Other studies performed under the EEAP have been performed at this installation. Criteria for both the study and the resulting documentation has changed since the previous study was completed. This study is intended to reevaluate selected projects from the previous study which have not been implemented nor programmed for implementation and to consider specific ECOs in buildings and areas that may have been overlooked previously or recently identified.

2.2 The information and analysis outlined herein are considered to be minimum essentials for adequate performance of this study.

2.3 The AE shall ensure that all methods of energy conservation which will reduce the energy consumption of the installation in compliance with the Energy Resources Management Plan including those listed in Annexes A1, A2, & A3 have been considered and documented. All methods of energy improvements of operational methods and procedures as well as the physical facilities. All energy conservation opportunities which produce energy or dollar savings shall be documented in this report. Any energy conservation opportunity considered infeasible shall also be documented in the report with reasons for elimination. ~~A list of general conservation opportunities (ECOs) to be used when evaluating specific buildings or areas is included as Annexes A1, A2, &~~

conservation which are reasonable and practical shall be considered including

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for this installation. ~~These~~ These lists shall be considered and the evaluation of each ECO documented in the report. ~~These lists are not intended to be restrictive but only to assure that basic and generally repetitive opportunities are addressed in the report. Some of the energy conservation opportunities in Annexes A, B, & C may not be applicable to the specific building or area at this installation. A statement to that effect is all that is required.~~

2.4. The study shall include the energy consuming buildings or areas listed in Annexes A1, A2, & A3. The work in the areas may be reduced somewhat by building repetition.

2.5 The study shall consider the use of all energy sources. The energy sources may include electricity, natural gas, liquefied petroleum gas, bulk oil, other oil products, steam when procured, gasoline, coal, solar, etc.

CEHSC-FU-P, 15 June 89

2.6 The "Energy Conservation Investment Program (ECIP) Guidance", described in letter from CEHSC-FU, dated 25 April 1988, establishes criteria for ECIP projects and shall be used for performing the economic analyses of all ECOs and projects. Construction cost escalation for DD Form 1391 sub mission shall be calculated using the guidelines contained in AR 415-17 and the latest Tri-Service MCP Index. The Tri-Service MCP Index, when updated, is contained in the latest applicable edition of the Engineer Improvement Recommendation System (EIRS) bulletin.

2.7 Energy conservation opportunities determined to be technically and economically feasible shall be developed into projects acceptable to installation personnel. This may involve combining similar ECOs into larger packages which will qualify for ECIP or MCA funding, and determining, in coordination with installation personnel, the appropriate packaging and implementation approach for all feasible ECOs.

2.8 Projects which qualify for ECIP funding shall be identified, separately listed, and prioritized by the Savings to Investment Ratio (SIR).

2.9 All feasible non-ECIP projects shall be ranked in order of highest to lowest SIR.

~~2.10 At some installations Energy Conservation and Management (ECAM) funding will be used instead of ECIP funding. The criteria for each program is the same. The Director of Engineering and Housing will indicate which program is used at this installation. This Scope of Work mentions only ECIP, however, ECAM is also meant.~~

3. PROJECT MANAGEMENT

3.1 Project Managers. The AE shall designate a project manager to serve as a point of contact and liaison for work required under this contract. Upon award of this contract, the individual shall be immediately designated in writing. The AE's designated project manager shall be approved by the Contracting Officer prior to commencement of work. This designated individual shall be responsible for coordination of work required under this contract.

The Contracting Officer will designate a project manager to serve as the Government's point of contact and liaison for all work required under this contract. This individual will be the Government's representative.

3.2 Installation Assistance. The Commanding Officer at each installation will designate an individual who will serve as the point of contact for obtaining information and assisting in establishing contacts with the proper individuals and organizations as necessary to accomplish the work required under this contract.

3.3 Public Disclosures. The AE shall make no public announcements or disclosures relative to information contained or developed in this contract, except as authorized by the Contracting Officer.

3.4 Meetings. Meetings will be scheduled whenever requested by the AE or the Contracting Officer for the resolution of questions or problems encountered in the performance of the work. The AE and/or the designated representative(s) shall be required to attend and participate in all meetings pertinent to the work required under this contract as directed by the Contracting Officer. These meetings, if necessary, are in addition to the presentation and review conferences.

3.5 Site Visits, Inspections, and Investigations. The AE shall visit and inspect/investigate the site of the project as necessary and required during the preparation and accomplishment of the work.

3.6 Records

3.6.1 The AE shall provide a record of all significant conferences, meetings, discussions, verbal directions, telephone conversations, etc., with Government representative(s) relative to this contract in which the AE and/or designated representative(s) thereof participated. These records shall be dated and shall identify the contract number, and modification number if applicable, participating personnel, subject discussed and conclusions reached. The AE shall forward to the Contracting Officer within ten calendar days, a reproducible copy of the records.

3.6.2 The AE shall provide a record of requests for and/or receipt of Government-furnished material, data, documents, information, etc., which if not furnished in a timely manner, would significantly impair the normal progression of the work under this contract. The records shall be dated and shall identify the contract number and modification number, if applicable. The AE shall forward to the Contracting Officer within ten calendar days, a reproducible copy of the record of request or receipt of material.

3.7 Interviews. The AE and the Government's representative shall conduct entry and exit interviews with the Director of Engineering and Housing before starting work at the installation and after completion of the field work. The Government's representative shall schedule the interviews at least one week in advance.

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intended procedures for the survey and shall be conducted prior to commencing work at the facility. As a minimum, the interview shall cover the following points:

a. Schedules.

b. Names of energy analysts who will be conducting the site survey.

c. Proposed working hours.

d. Support requirements from the Director of Engineering and Housing.

3.7.2 Exit. The exit interview shall include a thorough briefing describing the items surveyed and probable areas of energy conservation. The interview shall also solicit input and advice from the Director of Engineering and Housing.

4. SERVICES AND MATERIALS. All services, materials (except those specifically enumerated to be furnished by the Government), plant, labor, superintendence and travel necessary to perform the work and render the data required under this contract are included in the lump sum price of the contract.

5. PROJECT DOCUMENTATION. All energy conservation opportunities (ECOs) which the AE has considered shall be included in one of the following categories and presented in the report as such:

5.1 ECIP Projects. To qualify as an ECIP project, an ECO, or several ECOs which have been combined, must have a construction cost estimate greater than $200,000, a Savings to Investment Ratio (SIR) greater than one and a simple payback period of less than eight years. For ECAM and family housing projects, the $200,000 limitation may not apply. The AE shall check with the installation for guidance. The overall project and each discrete part of the project shall have a SIR greater than one. For all projects meeting the above criteria, complete programming documentation will be required. Programming documentation shall consist of a DD Form 1391, life cycle cost analysis summary sheet(s) (with necessary backup data to verify the numbers presented), and a project development brochure (PDB). A life cycle cost analysis summary sheet shall be developed for each ECO and for the overall project when more than one ECO is combined. For projects and ECOs reevaluated from the previous studies, the backup data shall consist of copies of the original calculations and analysis, with new pages revising the original calculations and analysis. In addition, the backup data shall include as much of the following as is available: the increment of work the project or ECO was developed under in the previous study, title(s) of the project(s), the energy to cost (E/C) ratio, the benefit to cost (B/C) ratio, the current working estimate (CWE), and the payback period. This information shall be included as part of the backup data. The purpose of this information is to provide a means to prevent duplication of projects in any future reports.

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criteria, but which have an overall SIR greater than one shall be documented. The life cycle cost analysis summary sheet shall be completed through and including line 6 for all projects or ECOs. Each shall be analyzed to determine if they are feasible even if they do not meet ECIP criteria. These ECOs or projects may not meet the nonenergy qualification test. For projects or ECOs which meet this criteria, the life cycle cost analysis summary sheet, completely filled out, with all the necessary backup data to verify the numbers presented, a complete description of the project and the simple payback period shall be included in the report. Additionally, these projects shall have the necessary documentation prepared, in accordance with the requirements of the Government's representative, for one of the following categories:

a. Quick Return in Investment Program (QRIP). This program is for projects which have a total cost less than $100,000 and a simple payback period of two years or less.

b. OSD Productivity Investment Funding (OSD PIF). This program is for projects which have a total cost greater than $100,000 and a simple payback period of four years or less.

c. Productively Enhancing Capital Investment Program (PECIP). This program is for projects which have a total cost greater than $100,000 and a simple payback period of four years or less.

The above programs are all described in detail in AR 5-4, Change No. 1.

d. Regular Military Construction Army (MCA) Program. This program is for projects which have a total cost greater than $200,000 and a simple payback period of eight to twenty-five years. Projects or ECOs which qualify for this program shall be economically analyzed in accordance with the requirements for Special Directed Studies in Engineering Technical Letter (ETL) 1110-3-332.

e. Low Cost/No Cost Projects. These are projects which the Director of Engineering and Housing can perform using his resources.

5.3 Nonfeasible ECOs. All ECOs which the AE has considered but which are not feasible, shall be documented in the report with reasons and justifications showing why they were rejected.

6. DETAILED SCOPE OF WORK. The general Scope of Work is intended to apply to contract efforts for all Army installations included under this contract except as modified by the detailed Scope of Work for each individual installation. The detailed Scope of Work is contained in Annexes A1, A2 & A3

7. WORK TO BE ACCOMPLISHED.

7.1 Review Previous Studies. The AE shall review for general information the previous EEAP study along with any other energy studies performed at the installation. This review should acquaint the AE with the work that has been performed previously. Much of the information the AE may need to develop the

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ECOs in this project will be contained in the previous studies. The survey data contained in the previous study should be very helpful to the results of this study.

7.2 Reevaluate Selected Projects. The AE shall reevaluate the projects and ECOs listed in Annexes A1, A2, & A3. These projects and ECOs are projects and ECOs that the previous study has identified but that have not been accomplished or only parts have been accomplished. If the project or ECO is acceptable as is, that is, there are no changes to the basic project or ECO, the energy savings shown in the previous project may be accepted as accurate but the energy cost and construction cost estimates shall be updated based on the most current data available. With the above information the project shall then be analyzed based on current ECIP criteria. If the project or ECO is basically acceptable but some of the buildings in the original project have been deleted or new buildings can be added, the necessary changes shall be made to the energy saving, the energy costs and construction costs shall be updated and the revised project or ECO shall then be analyzed using current ECIP guidance. If the original project or ECO has had numerous changes made to it so that all of the numbers are suspected of being inaccurate, but the project or ECO is still considered feasible, the AE shall develop the project from the beginning and analyze it with the current ECIP guidance. These projects shall be separately listed in the report.

A1, A2 A3

7.3 Evaluate Selected ECOs. The AE shall analyze the ECOs listed in Annex D. These ECOs shall be analyzed in detail to determine their feasibility. Savings to Investment Ratios (SIRs) shall be determined using current ECIP guidance. The necessary data required for these projects may not be available, requiring the AE to visit the installation to obtain any necessary information. The AE shall provide all data and calculations needed to support the recommended ECO. All assumptions shall be clearly stated. Calculations shall be prepared showing how all numbers in the ECO were figured. Calculations shall be an orderly step-by-step progression from the first assumption to the final number. Descriptions of the products, manufacturers catalog cuts, pertinent drawings and sketches shall also be included. A life cycle cost analysis summary sheet shall be prepared for each ECO and included as part of the supporting data. For ECOs which would replace the existing heating, ventilating, and air conditioning (HVAC) system or significantly change it (such as converting a multizone system to a variable air volume (VAV system)) the AE is required to run a computer simulation to analyze the system and to determine the energy savings. This requirement to use computer modeling applies only to heated and air conditioned or air conditioned only buildings which exceed 8,000 square feet or heated only buildings in excess of 20,000 square feet. The computer program shall analyze the building on an hour-by-hour basis rather than the bin data method or bin data to simulate an hour-by-hour analysis. Unless the Building Loads Analysis and System Thermodynamic (BLAST) program is used, the AE shall submit a sample computer run with an explanation of all input and output data and a summary of program methodology and energy evaluation capabilities for approval by the Contracting Officer prior to use of the program for analysis. The computer program used must be comparable to the BLAST program. The use of the LCCID computer program may be used if requested in writing.

7.4 Perform a Limited Site Survey. The AE shall conduct a limited site survey to evaluate the buildings or areas listed in Annexes A1, A2, & A3. The list of ECOs in Annexes A1, A2, & A3 shall be used when evaluating these building or areas. This list is not intended to be restrictive but only to assure that these opportunities, as a minimum, are considered, discussed and documented in the report. The AE may be aware of other ECOs not included in Annexes A1, A2, & A3 that will produce energy, manpower or dollar savings. These should be evaluated the same4 as the other ECOs. Each of the items shall be considered and discussed in the report. Those items on the list which are not practical, have been previously accomplished, are inappropriate or can be eliminated from detailed analysis based on preliminary analysis shall be listed in the report along with the reason for elimination from further analysis. All potential ECOs which are not eliminated by preliminary considerations shall be thoroughly documented and evaluated as to technical and economic feasibility. The AE shall obtain all the necessary data to evaluate the ECOs by conducting a site survey. However, the AE is encouraged to use any data that may have been documented in a previous study. The AE shall document his site survey on forms developed for the survey, or standard forms, and submit these completed forms as part of the report. All test and/or measurement equipment shall be properly calibrated prior to its use.

7.5 Provide Programming or Implementation Documentation. For projects or ECOs reevaluated or developed during this study, complete programming or implementation documentation shall be prepared by the AE.

7.5.1 Programming Documentation. For projects or ECOs which meet ECIP criteria and which the installation wants to submit as an ECIP project, complete programming documentation shall be prepared. Complete programming documentation consists of DD Form 1391, Project Development Brochure (PDB) and supporting data. These forms shall be separate from the narrative report. They shall be bound similarly to the final report in a manner which will facilitate repeated disassembly and reassembly.

7.5.1.1 Military Construction Project Data (DD Form 1391). These documents shall be prepared in accordance with AR 415-15 and the supplemental requirements in Annex C. A complete DD Form 1391 shall be prepared for each project. The form shall include a statement that the project results from an EEAP study. Documents shall be complete as required for submission to higher DA headquarters. These programming documents will require review and signatures by the proper installation personnel. All documents shall be completed except for the required signatures.

7.5.1.2 Project Development Brochure (PDB). Preparation of the PDB requires the AE to delineate the functional requirements of the project as related to the specific site. The AE shall prepare PDBs in accordance with AR 415-20 and TM 5-800-3. Most projects will not require all4the forms and checklists included in the Technical Manual (TM). Only that information needed for the project shall be included. The PDB-I format described in the TM shall be used for whatever information is needed.

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normally do not meet ECIP criteria, implementation documentation shall be prepared. Each feasible project or ECO shall be individually packaged and fully documented and included as a separate section in the volume containing the programming documentation. Each project or ECO shall have a complete description of the changes required, economic justifications, sketches, and other backup data included as a section in the report. The documentation required will be as determined by the Government's representative. Documentation required will be in the categories listed in paragraph 5.2. For the QRIP, OSD PIF and PECIP projects, documentation shall be prepared in accordance with the requirements of AR 5-4, Change No. 1. A sample implementation document, consisting of a DA Form 5108-R, sketches and manufacturers data and a life cycle cost analysis summary sheet shall be submitted for review and approval. This sample shall be submitted with the interim submittal. This sample shall be approved before any other implementation documents are prepared. To the degree possible, the project or ECO selected for the sample submission shall be typical of the majority of subsequent projects to be submitted. The sample shall consist of complete implementation documents with primary emphasis on format and manner of presentation rather than precise accuracy of cost estimates and energy savings data. For MCA projects the documentation required shall be in accordance with paragraph 7.5.1 except that the economic analysis required by ETL 1110-3-332 shall be included in lieu of the ECIP life cycle cost analysis. For low cost/no cost projects which the Director of Engineering and Housing personnel can perform, the following information shall be provided:

a. Brief description of the project.

b. Brief description of the reasons for the modification.

c. Specific instructions for performing the modification.

d. Estimated dollar and energy savings per year.

e. Estimated manhours and labor and materials costs. Costs shall be calculated for the current calendar year and so marked. Manhours shall be listed by trade. For projects that would repair an existing system so that it will function properly, also include the estimated manhours by trade and labor and material costs necessary to maintain the system in that condition. Some of the simple practical modifications may be developed on a per unit basis. An example of this type of modification would be the repair or replacement of steam traps on an as needed basis. As a rule, however, the AE should develop complete projects, if at all possible, rather than per unit modifications. Separate sheets for each project showing the above information shall be prepared and included in the report.

7.6 Submittals, Presentations and Reviews. The work accomplished shall be fully documented by a comprehensive report. The report shall have a table of contents and be indexed. Tabs and dividers shall clearly and distinctly divide sections, subsections, and appendices. All pages shall be numbered. The AE shall give a formal presentation of all but the final submittal to installation, command, and other Government personnel. During the presen-

tation, the personnel in attendance shall be given ample opportunity to ask questions and discuss any changes deemed necessary to the study. A review conference will be conducted the same day, following the presentation. Each comment presented at the review conference will be discussed and resolved or action items assigned. The AE shall provide the comments from all reviewers and written notification of the action taken on each comment to all reviewing agencies within three weeks after the review meeting. It is anticipated that each presentation and review conference will require approximately one working day. The presentation and review conferences will be at the installation on the date(s) agreeable to the Director of Engineering and Housing, the AE and the Government's representative. The Contracting Officer may require a resubmittal of any document(s), if such document(s) are not approved because they are determined by the Contracting Officer to be inadequate for the intended purpose.

7.6.1 Interim Submittal. An interim report shall be submitted for review after completion of the field survey and an analysis has been performed on all of the ECOs. The report shall indicate the work which has been accomplished to date, illustrate the methods and justifications of the approaches taken and contain a plan of the work remaining to complete the study. Calculations showing energy and dollar savings and SIRs of all the ECOs shall be included. The simple payback period of all ECOs shall be calculated and shown in the report. The AE shall submit the Scope of Work and any modifications to the Scope of Work as an appendix to the report. A narrative summary describing the work and results to date shall be a part of this submittal. During the review period, the Government's representative shall coordinate with the Director of Engineering and Housing and provide the AE with direction for packaging or combining ECOs for programming purposes and also indicate the fiscal year for which the programming or implementation documentation shall be prepared. A sample implementation document (DA Form 5108-R, sketches and manufacturers data, life cycle cost analysis summary sheet and supporting data) for one project shall be submitted with this submittal for review and approval. The survey forms completed during this audit shall be submitted with this report. The survey forms only may be submitted in final form with this submittal. They should be clearly marked at the time of submission that they are to be retained. They shall be bound in a standard three-ring binder which will allow repeated disassembly and reassembly of the material contained within.

7.6.2 Prefinal Submittal. The AE shall prepare and submit the prefinal report when all work under this contract is complete. The AE shall submit the Scope of Work for the installation studied and any modifications to the Scope of Work as an appendix to the submittal. The report shall contain a narrative summary of conclusions and recommendations, together with all raw and supporting data, methods used, and sources of information. The report shall integrate all aspects of the study. The report shall include an order of priority by SIR in which the recommended ECOs should be accomplished. The synergistic effects of all of the ECOs on one another shall have been determined and the results of the original calculations adjusted accordingly. Completed programming and implementation documents for all recommended projects shall be included. The programming and implementation documents shall be ready for review and signature by the installation commander. The prefinal

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report, separately bound Executive Summary, [illegible]
in standard three-ring binders which will allow repeated disassembly and reassembly. The prefinal submittal shall be arranged to include (a) a separately bound Executive Summary to give a brief overview of what was accomplished and the results of this study using graphs, tables and charts as much as possible (See Annex D for minimum requirements), (b) the narrative report containing a copy of the Executive Summary at the beginning of the volume and describing in detail what was accomplished and the results of this study, (c) appendices to include the detailed calculations and all backup material and (d) the programming and implementation documentation. A list of all projects and ECOs developed during this study shall be included in the Executive Summary and shall include the following data from the life cycle cost analysis summary sheet: the cost (construction plus SIOH), the annual energy savings (type and amount), the annual dollar savings, the SIR, the simple payback period and the analysis date. For all programmed projects also include the year in which it is programmed and the programmed year cost.

7.6.3 Final Submittal. Any revisions or corrections resulting from comments made during the review of the prefinal report or during the presentation and review conference shall be incorporated into the final report. These revisions or corrections may be in the form of replacement pages, which may be inserted in the prefinal report, or complete new volumes. Pen and ink changes or errata sheets will not be acceptable. If replacement pages are to be issued, it shall be clearly stated with the prefinal submittal that the submitted documents will be changed only to comply with the comments made during the prefinal conference and that the volumes issued at the time of the prefinal submittal should be retained. Failure to do so will require resubmission of complete volumes. If new volumes are submitted, they shall be in standard three-ring binders and shall contain all the information presented in the prefinal report with any necessary changes made. Detailed instructions of what to do with the replacement pages should be securely attached to the replacement pages.

ANNEX A1

Detailed Scope of Work

for an

Energy Savings Opportunity Survey (ESOS)

at

Fort McNair, Washington, DC

Pages A-1 thru A-~~4~~ 6

The following detailed requirements amplify, modify, or add to the referenced paragraphs of the General Scope of Work for the subject study.

1. 2.6 Use an SIOH value of 5.5% in ECIP Guidance, Life Cycle Cost Analyses.

2. 3.0 Add the following:

Point of contact at Ft. McNair is :

Commander
U.S. Army Military District of
Washington
ATTN: ANEN-RM, (Mrs. Joan Johnson)
Fort Lesley J. McNair, Washington DC
20319-5050

Point of contact at Baltimore District is:

COMMANDER
U.S. Army Engineer District, Baltimore
ATTN: CENAB-EN-D (Mr. James Hawk)
P.O. Box 1715
Baltimore, Maryland 21203-1715

3. 1.1 ~~and 2.1~~ 1.2, 2.1, 7.1 & 7.2 Delete these contract requirements at this installation.

4. 7.5.1.2 Delete this contract requirement at this installation.

5. 7.5.2 The fiscal year to which all projects should be estimated for programming or implementation documents shall be ~~FY 92~~ determined at the interim review conference

6. 7.6 Add the following schedule requirements: The work and services to be provided by the contractor under this contract shall be performed within the indicated number of calendar days:

a.	NTP to Interim Submittal Report	122 Days
b.	Interim Review Conference	163 Days
c.	Interim Report Approval	164 Days
d.	Prefinal Submittal	250 Days
e.	Prefinal Review Conference	293 Days
f.	Prefinal Approval	294 Days
g.	Final Submittal	324 Days

7. 7, 6.3 ~~All calculations for the final report to the using agency shall be submitted on a spreadsheet format floppy disk. The format will be determined during negotiations. The final report to the using agency shall consist of three hard copies.~~ A copy of the final report shall be sent to the Mobile District, Mobile, AL in addition to item 2 after final approval.

8. 7.6.4 Submittals of reports and minutes shall be transmitted directly to the agencies listed below in the quantities noted. An informational copy of all transmittal letters, shall be provided to CENAB-EN-D.

Agency	Reports	Minutes
USALEA, DALO-LEP	A	-----
USACE, CEEC-EE	A	-----
CENAB-EN-D	3	2
CENAD-EN-MM	A	1
ANEN-RM	5	1

Submittals will be mailed to: "A" - Executive Summary Only

COMMANDER
USALEA
ATTN: DALO-LEP (Mr. Keath)
NCAD
New Cumberland, PA 17070-5007

COMMANDER
HQUSACE
ATTN: CEEC-EE (Mr. Beranek)
Washington, DC 20314

COMMANDER
U.S. Army Engineer District, Baltimore
ATTN: CENAB-EN-D (Mr. Hawk)
P.O. Box 1715
Baltimore, MD 21203-1715

COMMANDER
U.S. Army Military District of Washington
DCSEH ATTN: ANEN-RM (Mrs. Joan Johnson)
Fort Lesley J. McNair
Washington, DC 20319-5050

10. The buildings and ECO's to be surveyed are listed on the enclosed matrix. Clarification notes for the ECO's are as follows:

a. Intended scopes of investigation for lighting ECO's are:

(1) Light Intensity Controls - Study fluorescent dimming systems as well as energy saving fluorescent lamps and ballasts.

(2) Light Level Controls - Study control of non-florescent lighting levels such as shut off with ~~electric eye~~ photo cell, etc.

(3) Lighting - Study use of more efficient lighting such as replacement of incandescent lights to meet IES standards, suggest alternate methods such as additional switches, ballast power reducer, ambient light relationships, flex-watt, and fixture/computer relationships and infrared type wall box switches.

b. High Efficient Motors - Study all 25 HP and higher rated motors for high efficiency replacement. Provide a list of defective motors as part of this study that should be replaced.

c. Day-Rooms - Investigate all day rooms for ECO's. Illumination level-required in these areas is 30 footcandles.

d. [illegible] - A/E shall include in his ECO investigation on analysis of the building's ventilation system as to health code requirements, individual room requirements, and whether the system meets ASHRAE standards.

e. Drawings for these buildings maybe reviewed at Building 203 at Fort Myer, VA, telephone number 703-696-6728 between the hours of 9 a.m. and 3 p.m.

11. All work in these buildings must be scheduled 10 days in advance.

~~12. Energy savings for ECO's shall be summarized in the following table:~~

~~a. Dollars/year~~

~~b. MBTU's saved/year/fuel~~

Delete this item as it is required by contract.

13 a. Model Buildings - A/E shall model these buildings to determine energy efficiency and potential energy savings in accordance with paragraph 7.4 of the Scope of Work.

Adds

b. Ice Production Storage - A/E shall investigate all ECO's to determine if this process can economically reduce the peak demand of electrical use during the cooling season.

c. Stand by Generators - A/E shall investigate all ECO's to determine if this process can economically reduce the peek demand of electrical use during the cooling season.

Ft McNair

BUILDING NUMBERS	1	7	8	16	17	19	20	21	23	19	31	11	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
HANGER DOOR WEATHER STRIP																							
CEILING INSULATION																							
CEILING PLENUM DUCTS																					X		
LIGHT INTENSITY CONTROL											X	X	X		X	X		X			X	X	X
WALL INSULATION																							
SOLAR HEAT / HOT WATER																							
IMPROVE POWER FACTOR	X	X	X	X	X	X	X	X	X	X	X	X			X			X			X		
SOLAR FILM																							
VESTIBULES																							
DUAL FUEL																							
HIGH EFFICIENCY MOTORS	X	X	X	X	X	X	X	X	X		X	X											
SHOWER FLOW RESTRICTORS																					X	X	X
STEAM DISTRIBUTION within bldg on!											X	X	X			X	X	X		X	X	X	X
WINDOWS	X	X	X		X		X	X	X		X												
HANGER DOOR WEATHER STRIP													X	X					X				
LIGHT LEVEL CONTROLS											X	X	X		X	X		X			X	X	X
LIGHTING											X	X	X		X	X		X		X	X	X	X
DOORS																						X	X
HEAT RECLAIMATION																							
MODULAR OFFICES																							
HEAT PUMPS inside bldg New Plant & modify							X																X
FUEL OIL Study														X									

(Model I)

Point of contact at McNair is
Mr H. Schram / CENAC - MC.
Bldg 40
202 475-1139/86
ICE PRODUCTION TO [illegible]
PL [illegible]
STAND BY [illegible]

BUILDING NUMBERS	49	50	52	54	56	~~58~~		59	60	61	~~55~~
... DUCTS											
LIGHT INTENSITY CONTROL								X		Δ	
WALL INSULATION											~~X~~
SOLAR HEAT / HOT WATER											
IMPROVE POWER FACTOR									X	X	
SOLAR FILM											
VESTIBULES											
DUAL FUEL											
HIGH EFFICIENCY MOTORS	X			X				X		X	
SHOWER FLOW RESTRICTORS		X	X	X	X	X	X	X		X	
STEAM DISTRIBUTION											
WINDOWS								~~X~~			
HANGER DOOR WEATHER STRIP		X	X	X				X		X	
LIGHT LEVEL CONTROLS	X	X	X		X		X	X	X	X	
LIGHTING											
DOORS											
HEAT RECLAIMATION											
MODULAR OFFICES											
HEAT PUMPS											
FUEL OIL								X		X	
STAND BY GEN								X		X	
ICE ...											
Waste Disposal Review											
DUPLICATE NUMBERS OF BLDS											

ANNEX B

REQUIRED DD FORM 1391 DATA

To facilitate project approval, the following supplemental data shall be provided:

a. In title block clearly identify projects, e.g. ECIP, QRIP, etc.

b. Complete description of each item of work to be accomplished including quantity, square footage, etc.

c. A comprehensive list of buildings, zones or areas including building numbers, square foot floor area, designated temporary or permanent, and usage (administration, patient treatment, etc.)

d. List references, and assumptions, and provide calculations to support dollar and energy savings, and indicate any added costs.

e. Each project shall be keyed to identify maintenance and new work costs.

(1) If a specific building, zone, or area is used for sample calculations, identify building, zone or area, category, orientation, square footage floor area, window and wall area for each exposure.

(2) Identify weather data source.

(3) Identify infiltration assumptions before and after improvements.

(4) Include source of expertise and demonstrate savings claimed. Identify any special or critical environmental conditions such as pressure relationships, exhaust or outside air quantities, temperatures, humidity, etc.

f. Claims for boiler efficiency improvements must identify data to support present properly adjusted boiler operation and future expected efficiency. If full replacement of boilers is indicated, explain rejection of alternatives such as replace burners, nonfunctioning controls, etc. Assessment of the complete existing installation is required to make accurate determinations of required retrofit actions.

fixtures. and wattage of each fixture being deleted and installe
New lighting shall be only of the level to meet current criteria
Lamp changes in existing fixtures is not considered an ECIP type
project.

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EXECUTIVE SUMMARY GUIDELINE

1. Introduction

2. Building Data (types, number of similar buildings, sizes, etc.)

3. Present Energy Consumption.

   a. Total Annual Energy Used.

   b. Source Energy Used.

      Electricty - KWH, Dollars, BTU

      Fuel Oil - GALS, Dollars, BTU

      Natural Gas - THERMS, Ddollars, BTU

      Propane - GALS, Ddollars, BTU

      Other - QTY, Dollars, BTU

4. Energy Conservation Analysis.

   - ECOs Investigated.
   - ECOs Recommended.
   - ECOs Rejected. (Provide economics or reasons)
   - ECIP Projects Developed. (Provide list)*
   - Non-ECIP Projects Developed. (Provide list)*
   - Operational or Policy Change Recommendations.

* Include the following data from the Life Cycle Cost Analysis Summary Sheet: the cost (construction plus SIOH), the annual energy savings (type and amount), the annual dollar savings, the SIR and the the analysis date. For all programmed projects also include the year in which it is programmed and the programmed year cost. Show the simple payback period for all ECOs.

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5. Energy and Cost Savings.

- Total Potential Energy and Cost Savings.
- Percentage of Energy Conserved.
- Energy Use and Cost Before and After the Energy Conservation Opportunities are Implemented.

6. Energy Plan.

- Project Breakouts with Total Cost and SIR.
- Schedule of Energy Conservation Project Implementation

A-7

ANNEX D

GOVERNMENT-FURNISHED DATA

NOT IN SERVICE

1. The following data shall be furnished by the Government for us on this project:

(a) Energy Resource Management Plan. ✓

~~(b) ETL 1110-3-254, Use of Electric Power for Comfort Space~~ Heating; 1110-3-282, Energy Conservation; and ~~1110-3-332~~2. [redacted] STUDIES [redacted] ECOMIC

(c) Energy Conservation Investment Program (ECIP) Guidance, dated 25 April 1988; CEHSC-FU-P 15 June 89,

(d) TM 5-785, Engineering Weather Data, TM 5-800-2, General Criteria Preparation of Cost Estimates, TM-5-800-3, Project Development Brochure.

(e) ~~AR 415-~~15, Military Construction Army (MCA) Program Development, AR 415-17, Cost Estimating for Military Programming; AR 415-20, Construction, Project Development and Design Approval; AR 415-28, Department of the Army Facility Classes and Construction Categories; AR 415-35, Construction, Minor Construction; AR 420-10, General Provisions, Organization, Functions, and Personnel; AR 11-27 Army Energy Program; and AR 5-4, Change No. 1, Department of the Army Productivity Improvement Program.

(f) The latest applicable Engineer Improvement Recommendation System (EIRS) bulletin, for purposes of cost estimation.

(h) An example of a correctly completed implementation document for a non-ECIP project.

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APPENDIX B- MEMORANDA AND LETTERS

Engineering Applications Consultants, P.C.

9004-B Crownwood Ct., Burke, Virginia 22015-1679; Phone (703) 978-0923; FAX: (703) 978-7331

TELEPHONE CONVERSATION SUMMARY

Project: Energy Savings Opportunity Survey, Fort AP Hill, Virginia

Contract (Client Project) No.: DACA 31-89-C-0198 EAC Project No.: 92008.00

From: JJS Telephone: ________ Date: 2/1/93

To: Jim Hawk, CENABEN-D Telephone: 410-962-3778 Time: 11:15 AM

Discussion:

1. The Original ESOS for Fort A.P. Hill was updated according to the scope requirements. The results of the updated ECO's have shown that the majority of the ECO's do not meet the current ECIP criteria for funding. The energy and installation costs have changed resulting in the change of the ECIP funding criteria.

2. The second part of the scope required EAC to calculate the implementation of installing new controls on heat pumps to avoid the use of the electric resistance heat as a source of heating. The installation cost and energy savings for this ECO could qualify for ECIP funding.

3. A meeting has been scheduled for Thursday February 11, 1993 at 10 am to discuss the next course of action for the project. Mr. Hawk indicated that he did receive our letter regarding the necessary changes to the scope of work in order to have the study to be accurate and effective in applying for construction funding.

4. Mr. Hawk indicated that the interim submission will be delayed. He is currently waiting to hear if the funding for our proposed scope changes will be available. Submission scheduling will be discussed when Mr. Hawk meets with EAC on 2/11/93.

Engineering Applications Consultants, P.C.

9004-B Crownwood Ct., Burke, Virginia 22015-1679; Phone (703) 978-0923; FAX: (703) 978-7331

TELEPHONE CONVERSATION SUMMARY

Project: Energy Savings Opportunity Survey, Fort AP Hill, Virginia

Contract (Client Project) No.: DACA 31-89-C-0198 EAC Project No.: 92008.00

From: Mr. John Solarczyk Telephone: 703-978-0923 Date: 2-23-94

To: Mr C.J. Kohan, Fort Lee Telephone: 804-734-3368 Time: 11:00 am

Discussion: RE: FM Radio Controls

1. I phoned Mr. Kohan at Fort Lee to discuss their existing Energy Management Control System (EMCS) controls. Fort Lee presently has an EMCS on base which controls the base lighting and HVAC systems. This system uses a radio frequency signal to turn lights and condensing units off during periods of high electrical demand.

   The Air conditioning units on base are grouped into four sectors. When the demand exceeds a certain level the EMCS will shut down one sector at a time for about 15 minutes. The EMCS will alternate the shutting off of each sector every 15 minutes.

   The system was installed in the early 80's and several upgrades have been implemented on the system. Mr. Kohan said to contact Mr. Ron Brown at Fort Lee for more detailed information. Mr. Brown operates the EMCS and keeps the maintenance on the system.

Mr. Ron Brown
EMCS Operator
Fort Lee, Virginia
804-734-5168 or
804-734-5230

cc: cc,pm

92008\telefone\022394b.tel

Engineering Applications Consultants, P.C.

9004-B Crownwood Ct., Burke, Virginia 22015-1679; Phone (703) 978-0923; FAX: (703) 978-7331

TELEPHONE CONVERSATION SUMMARY

Project: Energy Savings Opportunity Survey, Fort AP Hill, Virginia

Contract (Client Project) No.: DACA 31-89-C-0198 EAC Project No.: 92008.00

From: Mr. John Solarczyk Telephone: 703-978-0923 Date: 2-23-94

To: Mrs. Terry Banks, A.P. Hill Telephone: 804-633-8468 Time: 10:30 am

Discussion:

1. I called Terry to verify the numbers of new buildings and buildings with heat pumps that we sent them on December 17, 1993. Left message to return my call.

2/24/94- 2:30 pm-

Mr. John Culberson, Fort A.P. Hill staff returned my phone call. There are several buildings to be added to the heat pump list. His records indicate approximately 93 housing and our records only indicate 53. He said that he wouild update the building lists which were sent to Fort A.P. Hill on December 17 and fax a copy to EAC.

Inaddition to the heat pump buildings list, I asked him to review the new buildings list and make sure the numbers are correct and all buildings are on the list which were built after 1985. He said he would verifty all numbers.

John Culberon indicated that he would have some figures faxed up to EAC on Friday (2/25/94).

cc: cc,pm

92008\telefone\022494.tel

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TELEPHONE CONVERSATION SUMMARY

Project: Energy Savings Opportunity Survey, Fort AP Hill, Virginia

Contract (Client Project) No.: DACA 31-89-C-0198 EAC Project No.: 92008.00

From: Mr. John Solarczyk Telephone: 703-978-0923 Date: 2-18-94

To: Mr. Milton Seasile Telephone: 703-978-0923 Time: 1:45 pm

Discussion: RE: FM Radio Controls

I spoke with Mr. Milton Seasile regarding the water heater controls installed by the power company. He indicated that the controls are working great and they hardly notice any interruption from the power company or inconvenience when it occurs.

I asked if there were any on going negotiations with the power company to implement a similar program on air conditioning units. Mr. Seasile indicated that there was talk at one time, however, he was not involved in the talks.

I indicated that we will keep in contact regarding this program.

cc: cc,pm

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TELEPHONE CONVERSATION SUMMARY

Project: Energy Savings Opportunity Survey, Fort AP Hill, Virginia

Contract (Client Project) No.: DACA 31-89-C-0198 EAC Project No.: 92008.00

From: Mr. John Solarczyk Telephone: 703-978-0923 Date: 2-18-94

To: Mr. John Peck, Power Co. Telephone: 703-978-0923 Time: 10:15 am

Discussion: RE: FM Radio Controls

Rappahannock Electric Company currently supplies power to Fort A.P. Hill. Mr. John Peck is the Director of Field Engineering for the Bowling Green District (Fort A.P. Hill). The power company currently has the ability to turn off electric water heaters using a similar control method on base.

In exchange for letting the power company turn their water heaters off during periods of high demand, the base receives free maintenance on the heaters, a savings of $5.30 per KW for demand peak shaving, and a rider credit (reduced energy charges) for the period the water heaters were turned off.

The power company has the ability to turn off all or any one electric water heater via a signal through the transmission lines. The installation cost for the hardware and software was $0 for the base. The power company is in the process of negotiating with the utility commission to implement this same technology on air conditioning units at Fort A.P. Hill. Once approval is granted through the commission then the power company plans to implement the program to it's customers.

The power company is currently performing studies to implement the system on air conditioning units. They hope to have results from the study showing approximate savings and potential problems that may occur soon. Once the studies are complete and approval granted from the Utility Commision, they will have a plan ready for implementation.

Mr. Peck indicated that the company will probably implement the program in the same manner that the water heater program was implemented. The power company will pay for the materials and installation of the system provided the client (Fort A.P.Hill) will let them install the devices. He expects the program to be introduced to the customers in less than two years.

Mr. Peck said to contact Mr. Trible or Mr. Milton Seasile for more information. They were the contacts at Fort A.P. Hill on the program.

cc: Mr. Hawk
cc,pm

92008\telefone\021894.tel

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TELEPHONE CONVERSATION SUMMARY

Project: Energy Savings Opportunity Survey, Fort AP Hill, Virginia

Contract (Client Project) No.: DACA 31-89-C-0198 EAC Project No.: 92008.00

From: Mr. Tony Battaglia Telephone: 205-690-2168 Date: 1-13-94

To: Mr. Virender Puri Telephone: 703-978-0923 Time:

Discussion:

1. Tony has received our two letters regarding the grouping of the buildings and the discussion of the comments.

2. He expects to be on travel for a few days and would communicate his comments in a week to ten days

cc: Mr. Hawk
John Solarczyk
cc,pm

92008\telefone\011394-2.tel

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TELEPHONE CONVERSATION SUMMARY

Project: Energy Savings Opportunity Survey, Fort AP Hill, Virginia

Contract (Client Project) No.: DACA 31-89-C-0198 EAC Project No.: 92008.00

To: JJS Telephone: 703-978-0923 Date: 1-13-94

From: Jim Hawk, COE Telephone: 410-962-6704 Time: 11:00am

Discussion:

The information we sent to Jim, Tony, and John was not completely what they were looking for. The response to comments was approved. They were also looking for numbers (calculations, savings, cost, etc.) for the new buildings ECO's.

I explained to Jim that in order to get the numbers the whole report will have to be revised and organized for the final submission. We may need to field survey for a day or two and discuss with John Phyllin (Fort A.P. Hill) the building grouping's list and what ECO's would be applicable for each new building.

Jim indicated that he would like to have the ECO's packaged up for the final submittal in about two weeks or as soon as possible. I indicated that we were waiting on him to tell us the next course of action, however, we will now proceed with the final report.

92008\telefone\11394.tel

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TELEPHONE CONVERSATION SUMMARY

Project: Energy Savings Opportunity Survey, Fort AP Hill, Virginia

Contract (Client Project) No.: DACA 31-89-C-0198 EAC Project No.: 92008.00

To: JJS Telephone: 410-962-6704 Date: 1-3-94

From: Jim Hawk, COE Telephone: 703-978-0923 Time: 8:30am

Discussion:

Jim called regarding the interim meeting in November. He is waiting for response to comments and further clarification on the meaning of the comment "Will Comply" and how the questions raised will affect the final submission before they can approve the interim submission.

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TELEPHONE CONVERSATION SUMMARY

Project: Energy Savings Opportunity Survey, Fort AP Hill, Virginia

Contract (Client Project) No.: DACA 31-89-C-0198 EAC Project No.: 92008.00

From: JJS Telephone: ______ Date: 1-30-93

To: Charlie Wallace Honeywell Telephone: 301 621-2768 Time: -

Discussion:

The cost for a Honeywell thermostat model T8611 Chronotherm-3 is $315.85.

92008\telefone\master

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TELEPHONE CONVERSATION SUMMARY

Project: Energy Savings Opportunity Survey, Fort AP Hill, Virginia

Contract (Client Project) No.: DACA 31-89-C-0198 EAC Project No.: 92008.00

From: JJS Telephone: ______ Date: 1-25-92

To: Ron Hodges Telephone: 804-633-8201 Time: 2 30pm

Discussion:

1. Left message to return call. Request for information on operation of HVAC system in BLG 172 Food Prep Area.

Engineering Applications Consultants, P.C.

9004-E Crownwood Ct., Burke, Virginia 22015-1679; Phone (703) 978-0923; FAX: (703) 978-7331

TELEPHONE CONVERSATION SUMMARY

Project: Energy Savings Opportunity Survey, Fort AP Hill, Virginia

Contract (Client Project) No.: DACA 31-89-C-0198 EAC Project No.: 92008.00

From: Wayne Mason, Carrier Rep Telephone: 703 548 2045 Date: 1/2/92

To: John Solarczyk, PM Telephone: 978-0923 Time: 2:30pm

Discussion: The following Heat Pump Systems have the Associated Ratings:

BLG 172: (UNIT #2) model # 38YG060300
5TON, 8SEER, 7.5KW/TON
UNIT 3 model # 38YRQ054330
4.5TON, 8SEER, 6.75KW/TON
Unit #1 model 38YG042310
4TON, 8SEER, 6KW/TON
KITCHEN model 38EN048310
4TON, 6SEER, 8KW/TON

BLG 1253: units 1 & 2 model 38QN036300SM
3TON, 6SEER, 6KW/TON

BLG 174: model 38QN048310
4TON, 6SEER, 8KW/TON

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TELEPHONE CONVERSATION SUMMARY

Project: Energy Savings Opportunity Survey, Fort AP Hill, Virginia

Contract (Client Project) No.: DACA 31-89-C-0198 EAC Project No.: 92008.00

From: RICK LANE Telephone: 804 644-7846 Date: 12-29-92

To: JJS Telephone: 978-0923 Time: 330 PM

Discussion:

The cost for installing an automatic overhead door is approximately $3950 (15x12). The door is insulated to an R-6. The cost includes installation and Removal of old door.

92008\telefone\master

- overhead

- Richmond

JS Archer

804-644-7846

Pricing - overhead

John

Engineering Appl

A, ~~B, D, 6, F~~

A, 6

~~A~~, B, 6,

Cornwel

Insulated Rolling ~~&~~ overhead door

R= 6.33

15' high x 12' wide opening

model INSULATED SLAT #6R

Contact:

J S ARCHER

804 - 644 - 7846

motorized

Rick ~~Lan~~ LANE

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TELEPHONE CONVERSATION SUMMARY

Project: Energy Savings Opportunity Survey, Fort AP Hill, Virginia

Contract (Client Project) No.: DACA 31-89-C-0198 EAC Project No.: 92008.00

From: JS Telephone: Date: 12-16-92

To: MARC DUNCAN, EXTERIOR COATINGS Telephone: 703 550-7277 Time: 4:45

Discussion:

THE COST FOR THE DRYVIT EXTERIOR INSULATION FOR MASONRY BUILDINGS IS APPROXIMATELY $4.50/FT2 (LABOR - 2.16 MAT. - 2.34).

92008\telefone\master

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TELEPHONE CONVERSATION SUMMARY

Project: Energy Savings Opportunity Survey, Fort AP Hill, Virginia

Contract (Client Project) No.: DACA 31-89-C-0198 EAC Project No.: 92008.00

From: JJS Telephone: Date: 12-21-92

To: Terri Schrouder Telephone: 804 633-8398 Time: 2 PM

Discussion:

1. Scott Hedges will meet Mary Johnson in Building 172 at 10AM. For a field survey of the community Club.

2. Scott will meet Sherril Craddock in Building 142 Late morning or early Afternoon for an escort to Building 174 (Guest House).

3.

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TELEPHONE CONVERSATION SUMMARY

Project: Energy Savings Opportunity Survey, Fort AP Hill, Virginia

Contract (Client Project) No.: DACA 31-89-C-0198 EAC Project No.: 92008.00

From: Pete Wilson Telephone: Date: 12-18-92

To: JJS Telephone: Time: 11:30AM

Discussion:

1. THE EMCS system in the original Report needs to be redesigned. Since the completion of the study, the HARDWARE has changed and the design guidelines. Since it is not in our scope of work to redesign any of the calculations we will only update the cost For the interim submission.

92008\telefone\master

10

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TELEPHONE CONVERSATION SUMMARY

Project: Fort A P Hill

Project No.: ______ EAC Project No.: 92008

From: WS Telephone: ______ Date: 12-14-92

To: Carol FINCH Telephone: (804) 633-8468 Time: 9:10

Discussion:

1. Left message to Return call.

12-16-92 (3pm) 2. Returned phone call to Ken Comfort However he was NOT Available - Left message.

12-17-92 3. Carol Returned call. A survey date has been set for monday, 12-21-92. The following BLG'S will be surveyed: 172, 174, 1253. Carol indicated That the following personnel ARE IN CHARGE OF Those BUILDINGS:

172 - Terri Schroeder 804 633-8398

174 - Billeting 633-8335

1253 - Joe Modley, DPTMS LOCATED IN BUILDING 126.

eacforms\telefone

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9004-B Crownwood Ct., Burke, Virginia 22015-1679; Phone (703) 978-0923; FAX: (703) 978-7331

TELEPHONE CONVERSATION SUMMARY

Project: FORT AP HILL

Project No.: 92008 EAC Project No.:

From: WS Telephone: Date: 12/2/92

To: Joyce Telephone: 804 633-8201 Time: 1:50 PM

Discussion:

Requested Population Aggragate FOR THE PREVIOUS 5 years - Both MILITARY AND Civilian. This Request was initially ASKED FOR IN LATE OCTOBER.

eacforms\telefone

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9004-B Crownwood Ct., Burke, Virginia 22015-1679; Phone (703) 978-0923; FAX: (703) 978-7331

TELEPHONE CONVERSATION SUMMARY

Project: ESOS FORT AP HILL

Project No.: ______ EAC Project No.: 92008

From: JJS Telephone: - Date:

To: DAVE, Honeywell Telephone: 301 621-2768 Time: 11-15-92

Discussion:

Honeywell model T86-111 R1000 Thermostat is used for controlling the use of auxiliary heat in a heat pump system. THE THERMOSTAT AVOIDS THE use of Auxiliary heat by stepping up the space temp in 2° increments. The aux. heat is used only in cases where the outside air temp is very cold (10°F). The thermostat uses the room air as opposed to the O.A. conditions for determining the heating requirements.

The resistance heating is also used FOR FREEZE PROTECTION in the compressor/evaporator SECTION.

CARRIER

TYPICAL 50YQ, QT; 38QF, QN, QB

FUNCTION	EXISTING CONTROL TERMINAL DESIG.	STANDARD MANUAL CHANGE-OVER	DELUXE MANUAL CHANGEOVER		DELUXE AUTO CHANGEOVER		CHRONO-THERM UPGRADE [10]
		T841A1217 [1]	Y594R1615	Y594R1425	Y594G1252	Y594G1419	T8611R1000/ [6] T8611G1004 [2]
COMMON	C [5]	X [5]	X [5]	X [5]	X [5]	X [5]	C [5]
POWER	R	R	R	R	R	R	R
COM-PRESSOR	Y [2]	Y [2]	Y [2]	Y	Y [2]	Y1	Y1 (Y) [2]
1ST. STG. HEAT	-	-	-	W1 [6]	-	W1 [6]	W1 [6]
AUX. HEAT	(W1) W2	W2	W2	W2	W2	W2	W2
FAN	G	G	G	G	G	G	G
C/O VALVE HEAT	-	B	B	B	-	B	B
C/O VALVE COOL	O	O	O	O	O	O	O
SYSTEM MONITOR	(F) L [3]	L	L	L	L	X1	L or X1 [9]
EM. HEAT	E	E	E	E	E	E	E [7]
MULTIPLE AUX. HEAT LOADS [4]	-	W3	W3	W3	W3	W3	[10]
CHECK LED	-	-	-	X2 [8]	-	X2 [8]	X2 [9]

[1] T841A1217 provides emergency heat, system monitor, and auxiliary heat LEDs. If you don't need LED indication, use T841A1050.

[2] Both first stage heat and cool are connected to Y terminal.

[3] If provided on original equipment.

[4] Terminal is for multiple second stage loads such as contactors, sequencers, or relays.

[5] Terminal X(C) must be connected to transformer common.

[6] Leave factory-installed jumper in place.

[7] Optional CHECK LED. Connect X1 to switching device, jumper X2 to C.

[8] Field-installed X2 to X jumper (provided).

[9] Optional CHECK LED on T8611G1004. Connect L(F) to X1; jumper X2 to C.

[10] T8611R1000 is manual changeover. T8611G1004 is automatic changeover.

Post-It™ brand fax transmittal memo 7671	# of pages ▸ 2
To WM SOLARTZYK	From DAVID BROMERY
Co. ENG. APPLIC. CORP.	Co. HONEYWELL
Dept.	Phone # 301/621-2768
Fax # 703/978-7331	Fax # 410/684-3394

(Continued on next page)

14

(Continued from page 14)

TYPICAL THERMOSTATS AND SUBBASES — HONEYWELL MODEL NUMBER (CUSTOMER PART NUMBER)

T841C1009 (HH07AT180)
T872G1075/Q672J1054 (HH07AT171/HH93AZ173)
T872G1075/Q672L1052 (HH07PZ085/HH93AZ075A)
T874C1166 (HH07AT160)
T874D1272 (HH07AT162)
T874G1055/Q674J1035 (HH07AT171/HH93AZ173A)
T874G1055/Q674J1118 (HH07AT171/HH93AZ188)
T874G1055/Q674L1041 (HH07AT171/HH93AZ175A)
T874G1055/Q674L1397 (HH07AT171/HH93AZ185A)
T874G1055/Q674P1005 (HH07AT171/HH93AZ169)
T874G1071/Q674P1005 (HH07AT171/HH93AZ169)
T874G1121 (HH07AT161)
T874G1717/Q674J1167
T874H1070/Q674B1406 (HH07AT166/HH93AZ200)
T874H1070/Q674C1322 (HH07AT166/HH93AZ199)
T874H1088/Q674B1406 (HH07AT166/HH93AZ200)
T874H1088/Q674C1322 (HH07AT166/HH93AZ199)
T874J1002/Q674L1074 (HH07AT175/HH93AZ186)
T874L1000/Q674E1270 (HH07AT176/HH93AZ189)
T874L1018/Q674B1356 (HH07AT178/HH93AZ192)
T874L1018/Q674C1264 (HH07AT178/HH93AZ193)
T874R1319/Q674B1281 (42QH400083/42QH400103)
T874R1384/Q674L1439 (HH07AQ170/HH93AZ187)
T874R1384/Q674L1579 (HH07AQ170/HH93AZ198)
T874V1008/Q674R1003 (HH07AT177/HH93AZ190)
T8085R1007/Q682L1002 (HH07AT075/HH93AZ159C)
T8085R1023/Q682L1028 (HH07AT075C/HH93AZ159C)

See page 1 for additional cross reference information.

Engineering Applications Consultants, P.C.

9004-B Crownwood Ct., Burke, Virginia 22015-1679; Phone (703) 978-0923; FAX: (703) 978-7331

TELEPHONE CONVERSATION SUMMARY

Project: FORT AP HILL

Project No.: ______ EAC Project No.: 92008

From: JJS Telephone: ______ Date: 11-13-92

To: JIM HAWK, USACE Telephone: 410) 962 3778 Time: 9AM

Discussion:

We are to use the escalation Rates that were used for FORT McNAIR. A meeting on November 18 1992 at 10 am has been scheduled to discuss the project.

eacforms\telefone

Engineering Applications Consultants, P.C.

9004-B Crownwood Ct., Burke, Virginia 22015-1679; Phone (703) 978-0923; FAX: (703) 978-7331

TELEPHONE CONVERSATION SUMMARY

Project: FORT AP HILL

Project No.: ______ EAC Project No.: 92008

From: JJS Telephone: ______ Date: 11-9-92

To: JOHN SHERROD, NOAA Telephone: 301 443-8330 Time: 1030AM

Discussion:

Requested the cooling AND Heating DEGREE DAYS FOR EACH year FROM 1980 to the most current data on record. In addition to the DD FOR Richmond and FT Belvoir (WASH. D.C.) I also requested the normals, means AND extremes FOR The two AREAS.

eacforms\telefone

Engineering Applications Consultants, P.C.

9004-B Crownwood Ct., Burke, Virginia 22015-1679; Phone (703) 978-0923; FAX: (703) 978-7331

TELEPHONE CONVERSATION SUMMARY

Project: FORT AP HILL

Project No.: ______ EAC Project No.: 92008

From: JJS Telephone: ______ Date: 11-9-92

To: Pete RITCHIE Telephone: 804 633-8468 Time: 8 45 am

Discussion:

They ARE HAVING TROUBLE LOCATING DRAWINGS on BUILDINGS 174, 1220, AND 1263 FOR USE in determining the computer modeling analysis for Heat pump controls.

I will perform a field survey on 11/10/92 To FIND DRAWINGS AND FINISH FIELD SURVEY.

eacforms\telefone

Engineering Applications Consultants, P.C.

9004-B Crownwood Ct., Burke, Virginia 22015-1679; Phone (703) 978-0923; FAX: (703) 978-7331

FAX TRANSMITTAL

TO: Fort A.P. Hill	DATE: 11-03-92
ATTN: Mr. Dennis Getty	RE: Energy Savings Opportunity Survey Fort A.P. Hill, Virginia
CLIENT PROJ. NO. DACA 31-89-C-0198	
FAX NO. (804) 633-8443	EAC PROJECT NO. 92008.00

Gentlemen:

We are sending you the following items consisting of 4 pages including cover sheet.

Hard copy to be sent: [ ] YES [X] NO

DESCRIPTION

The letter dated September 25 was sent to Mr. Ken Comfort. The items circled have not been provided to EAC. Enclosed with the fax is a list of buildings that need to be field surveyed.

REMARKS

REPLY

If you do not receive the required number of pages, please contact sender at (703) 978-0923.

SENDER John Solarczyk

B\92008\fax\110392

19

September 25, 1992

Department of the Army
Commander
U.S. Army Garrison
Fort A.P. Hill
Bolling Green, Virginia 22427-5000

Attention: Mr. Kenneth Comfort, Code AFKA-FHE-PS
Chief, Engineering, Plans and Services

Re: Energy Savings Opportunity Survey
Fort AP Hill, Virginia
Contract Number: DACA 31-89-C-0198
EAC Project Number: 92008.00

Dear Mr. Comfort:

The Fort A.P. Hill Energy Study (Contract Number DACA 65-81-C-0021) performed in 1981 is being updated by our firm. On June 30, 1992, we had a meeting with Terry Banks, John Phyllin, and James Hawk (Baltimore District Corps of Engineers) concerning the updating of the Fort A.P. Hill Energy Study. In order to complete the study we will need the following information from you as soon as possible:

1. A list coordinating the existing building numbers with those used under Contract DACA 65-81-C-0021 (Fiscal Year 1981).

2. Identify (on the same list as provided from Number 1 above) all the buildings that have been demolished since the date of the study (Fiscal Year 1981).

3. Provide a separate list of newly constructed buildings and their drawings since the completion of DACA 65-81-C-0021.

4. Provide a list of current buildings and their drawings with heat pumps as source of air conditioning and heating.

5. Provide drawings for Buildings 101, 126, 179, 214, 311, 313, 820, 821, 1290, and 1528.

6. Provide up to 5 years of energy bills for all fuels (electric, oil, propane, etc.) used at the post.

7. Contact persons for: Carolyn Finch -

   Access and other general information
   Utilities

8. Working hours and arrangements for access to the buildings.

9. Security and/or escort requirements.

10. Letter of authorization to perform the site surveys. Survey personnel will carry this letter as explanation for the purpose of their visit when without an escort.

11. Parking restrictions.

12. Procedures for taking pictures.

13. Current utility rate structures for:

    gas/propane/oil
    electric service

14. Projected future utility rate structures for:

    gas/propane/oil
    electric service

15. Account and contact person at Rappahannock Power, and authorization for releasing billing information and tapes for power consumption. call Rappahannock

16. Building profiles for new buildings and buildings with heat pumps including the following:

    Number of people that normally occupy each building.
    Maximum listed occupancy for each building.
    Daily schedules for use in each building.
    (24 hours/day, nights, weekends only, etc.)

Updating the study will entail updating old calculations to new standard calculations; updating construction costs for proposed energy conservation opportunities (ECOs); identifying ECOs that were recommended in the previous study and determine if any of them were implemented; and analyze the energy consumption of the base. The above mentioned items are a few of the tasks involved in completing this study.

Upon receipt of this letter, if you have any questions about any information requested, please don't hesitate to call. We are looking forward to working with you on this project and will be talking with you in the near future.

Sincerely,

ENGINEERING APPLICATIONS CONSULTANTS, P.C.

John Solarczyk
Mechanical Engineer

Enclosures: List of Buildings in the 1981 Study

js:cag

cc: cc, pm

92008\letters\092592

1.0 The following buildings will need to be field surveyed:

1528, 1252, 1253, 1350, 290, 1356, 1248, 1237, 1836, 1335, 172, 413, 236,

188, 189, 269, 384, 415, 1337, 1432, 1559, 1561, 1562, 1610, 1612.

2.0 Mechanical Rooms in Buildings: 311, 820, 821, 179.

3.0 A list of buildings that are winterized; dates they are winterized and dewinterized.

4.0 The LP Gas fuel bills for the past 5 years.
Fuel oil #2 bills for September and October, 1991 and January and October 1989.
Electricity bills for May and June 1989, July and August 1990, May and December 1991,

5.0 The military aggragate strength for 1989-1992.

Engineering Applications Consultants, P.C.

9004-B Crownwood Ct., Burke, Virginia 22015-1679; Phone (703) 978-0923; FAX: (703) 978-7331

TELEPHONE CONVERSATION SUMMARY

Project: Energy Savings Opportunity Survey, Fort AP Hill, Virginia

Contract (Client Project) No.: DACA 31-89-C-0198 EAC Project No.: 92008.00

From: JJS Telephone: (703) 978-0923 Date: 11/2/92

To: Ken Comfort Telephone: (804-633-8468 Time: 2 PM

Discussion:

1. Left Message for Mr. Comfort to return my call.

2. DENNIS GETTY PHONED. I FAXED MR GETTY ADDITIONAL INFORMATION on Buildings that need to be surveyed AND ~~A~~ information That was requested with the letter on September 25, 1992 to this date has not been supplied to EAC. I have requested ~~this~~ That this information be provided as soon as POSSIBLE.

October 27, 1992

Department of the Army
Baltimore District
Corps of Engineers
31 Hopkins Plaza
Baltimore, Maryland 21201

Attention: Mr. James Hawk (Code CENABEN-D), Room 1423
Project Manager

Re: Energy Savings Opportunity Survey
Fort AP Hill, Virginia
Contract Number: DACA 31-89-C-0198
EAC Project Number: 92008.00

Gentlemen:

We have performed a limited survey on the following buildings: 101, 126, 179, 311, 313, 820, 821, and 1290 to determine if any of the previous recommended ECOs have been implemented.

Buildings 101 and 126 have been remodeled since the study was completed. Additional insulation, storm windows, and aluminum siding was added to these buildings. Building 179 consists of company head quarters barracks and a dining facility. The dining hall has been closed for conversion to a gymnasium and storage area. Building 313 is the post fire station. An addition was made to this building in 1986 to house the firefighters. The addition utilizes its own heating and air conditioning system and a hot water heater. The modifications to these buildings will impact the synergistic affect for the energy savings calculated in the previous report.

Since the completion of the Energy Savings Opportunity Survey at Fort A.P. Hill, 110 new buildings have been constructed in lieu of the estimated 12 new buildings. The new buildings will be categorized under the subgroups in the initial report. We will field survey 12 of the 110 new buildings to verify the new construction characteristics.

There are 66 buildings on Fort A.P. Hill that utilize heat pump systems. We will computer model 3 of the 66 buildings to determine their existing energy use and to determine the effects of installing automatic control systems for heat pumps to avoid the use of electric heat elements as a primary source of heat. This will be a separate section in the report. All the buildings on the post having heat pumps, new or existing, will be classified in this group. One of each of the following building types shall be computer modeled: A masonry structure, a wood frame structure, and a metal skin structure.

Synergistic affects between the recommended ECOs and the addition of heat pump controls will be considered in the calculation of energy use and savings. The construction cost and energy savings (if any) from the addition of heat pump controls will then be added to the base-wide energy savings and construction cost figures in the report.

We will contact you in the next few days to discuss in further detail the modifications or changes that may need to be made to the contract. If you have any questions regarding the project, please don't hesitate to contact us.

Sincerely,

ENGINEERING APPLICATIONS CONSULTANTS, P.C.

Virender Puri, P.E.
President

js:cag

cc: cc, pm

a\92008\letters\102792

- TO BE INCLUDED IN PAST PROJECTS - HVAC Systems CHANGES UNDER HEAT PUMP PERFORMANCE.

I. Since ~~the~~ majority of BLGS IN SUBGROUP HAVE NOT changed then leave computer modeled BUILDING type alone. THE CONV. TO A H.P. System in some buildings can be Related to the basewide energy increase since the buildings Before the conversion were not AIR conditioned.

II. CREATE Seperate category FOR HEAT PUMP CONVERSIONS MODEL ONE HEAT PUMP BUILDING FOR HEATING & COOLING ENERGY.

RE 4 MOS.

Engineering
Applications
Consultants

A Professional
Corporation

9004-B Crownwood Ct.
Burke, Virginia 22015-1630
(703) 978-0923

October 27, 1992

Department of the Army
Baltimore District
Corps of Engineers
31 Hopkins Plaza
Baltimore, Maryland 21201

Attention: Mr. James Hawk (Code CENABEN-D), Room 1423
Project Manager

Re: Energy Savings Opportunity Survey
Fort AP Hill, Virginia
Contract Number: DACA 31-89-C-0198
EAC Project Number: 92008.00

Gentlemen:

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We will contact you in the next few days to discuss in further detail the modifications or changes that may need to be made to the contract. If you have any questions regarding the project, please don't hesitate to contact us.

Sincerely,

ENGINEERING APPLICATIONS CONSULTANTS, P.C.

Virender Puri

Virender Puri, P.E.
President

js:cag

cc: cc, pm

a\92008\letters\102792

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9004-B Crownwood Ct.
Burke, Virginia 22015-1630
(703) 978-0923

September 25, 1992

Department of the Army
Commander
U.S. Army Garrison
Fort A.P. Hill
Bolling Green, Virginia 22427-5000

Attention: Mr. Kenneth Comfort, Code AFKA-FHE-PS
Chief, Engineering, Plans and Services

Re: Energy Savings Opportunity Survey
Fort AP Hill, Virginia
Contract Number: DACA 31-89-C-0198
EAC Project Number: 92008.00

Dear Mr. Comfort:

The Fort A.P. Hill Energy Study (Contract Number DACA 65-81-C-0021) performed in 1981 is being updated by our firm. On June 30, 1992, we had a meeting with Terry Banks, John Phyllin, and James Hawk (Baltimore District Corps of Engineers) concerning the updating of the Fort A.P. Hill Energy Study. In order to complete the study we will need the following information from you as soon as possible:

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3. Provide a separate list of newly constructed buildings and their drawings since the completion of DACA 65-81-C-0021.
4. Provide a list of current buildings and their drawings with heat pumps as source of air conditioning and heating.
5. Provide drawings for Buildings 101, 126, 179, 214, 311, 313, 820, 821, 1290, and 1528.
6. Provide up to 5 years of energy bills for all fuels (electric, oil, propane, etc.) used at the post.
7. Contact persons for:

   Access and other general information
   Utilities
8. Working hours and arrangements for access to the buildings.
9. Security and/or escort requirements.

10. Letter of authorization to perform the site surveys. Survey personnel will carry this letter as explanation for the purpose of their visit when without an escort.

11. Parking restrictions.

12. Procedures for taking pictures.

13. Current utility rate structures for:

    gas/propane/oil
    electric service

14. Projected future utility rate structures for:

    gas/propane/oil
    electric service

15. Account and contact person at Rappahanock Power, and authorization for releasing billing information and tapes for power consumption.

16. Building profiles for new buildings and buildings with heat pumps including the following:

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    Daily schedules for use in each building.
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Updating the study will entail updating old calculations to new standard calculations; updating construction costs for proposed energy conservation opportunities (ECOs); identifying ECOs that were recommended in the previous study and determine if any of them were implemented; and analyze the energy consumption of the base. The above mentioned items are a few of the tasks involved in completing this study.

Upon receipt of this letter, if you have any questions about any information requested, please don't hesitate to call. We are looking forward to working with you on this project and will be talking with you in the near future.

Sincerely,

ENGINEERING APPLICATIONS CONSULTANTS, P.C.

Varinder Oun

John Solarczyk
Mechanical Engineer

Enclosures: List of Buildings in the 1981 Study

js:cag

cc: cc, pm

92008\letters\092592

Engineering Applications Consultants, P.C.

9004-B Crownwood Ct., Burke, Virginia 22015-1679; Phone (703) 978-0923; FAX: (703) 978-7331

TELEPHONE CONVERSATION SUMMARY

Project: Energy Savings Opportunity Survey, Fort AP Hill, Virginia

Contract (Client Project) No.: DACA 31-89-C-0198 EAC Project No.: 92008.00

From: John Solarczyk Telephone: 703-978-0923 Date: 09/23/92

To: John Phillyn, DEH Telephone: 804-633-8255 Time: 8:30 a.m.

Discussion:

1. Discussed updating the energy study performed under Contract DACA 65-81-C-0021 (Fiscal Year 1981); and requested the following information:

   a. A list coordinating the existing building numbers with those used under Contract DACA 65-81-C-0021 (Fiscal Year 1981).

   b. Identify all buildings that have been demolished since the date of the study.

   c. Provide a separate list of newly constructed buildings since the completion of Contract DACA 65-81-C-0021.

   d. Provide a list of current buildings with heat pumps as a source of A/C and heating.

   e. Provide drawings for Buildings 101, 126, 179, 214, 311, 313, 820, 821, 1290, 1528.

   f. Provide up to 5 years of energy bills (electric, natural gas, oil, propane, etc.) of the post/buildings.

2. Mr. Phillyn indicated that Mr. Ken Comfort, Deputy Director for DEH, is our point of contact. He can be reached at 804-633-8468.

3. Mr. Solarczyk called Mr. Comfort's office and left a message for Mr. Comfort to call Mr. Solarczyk.

Prepared by John Solarczyk

cc, pm

92008\telefone\master

Engineering Applications Consultants, P.C.

9004-B Crownwood Ct., Burke, Virginia 22015-1679; Phone (703) 978-0923; FAX: (703) 978-7331

TELEPHONE CONVERSATION SUMMARY

Project: ENERGY SAVINGS OPPORTUNITY FORT AP HILL

Project No.: ______ EAC Project No.: 92008.00

From: JWS Telephone: ______ Date: 9/24/92

To: KEN Comfort Telephone: 804 633-8468 Time: 8:45

Discussion:

1. Left message for KEN Comfort to call (9/23/92)

2. Left message for Mr Comfort to Return call. (8:45am)

Engineering Applications Consultants, P.C.

9004-B Crownwood Ct., Burke, Virginia 22015-1679; Phone (703) 978-0923; FAX: (703) 978-7331

TELEPHONE CONVERSATION SUMMARY

Project: FORT AP HILL

Project No.: ______ EAC Project No.: 92008

From: JJS Telephone: ______ Date: ______

To: HANK GIGNILLIAT Telephone: 703 704-1545 Time: 9:30am

Discussion:

HANK IS SENDING EAC THE LATEST GUIDLINES FOR PERFORMING ECIP ANALYSIS.

eacforms\telefone

APPENDIX C- FIELD SURVEY DATA AND SHEETS

BUILDING 172

RECOMENDATION	IMPLEMENTED	
	YES	NO
Night Setback		✓
Replacement of inefficient Light Fixtures	✓	
Ceiling Insulation	✓	
Wall Insulation	✓	
Wall Insulation (CMU wall)	✓	
Caulking and Weatherstripping	✓	
Storm Windows DOUBLE PANE - 1/2" AG.	✓	
Replace Inefficient Site Lighting	NA	NA
Overhead Door Replacement	— N	A —
Timer Switches (water pumps, etc.		✓
Water Heater Controls		✓
Solar Domestic Water Heater	— N	A —
Trombe Wall Adaptation	— N	A —
Conversion To Wood Stoker Boiler	— N	A —
Photocell and Time Clock Controls for Lighting		✓
Replacement of Stand. Fluor. with High Eff. Light		✓
Selective Switching of Lights		✓
High Efficiency Motors		✓
Domestic Hot Water Circulating Pump Controls		✓
Insulated Damper Panels		✓
Elimination of Domestic Hot Water in Admin Blgs.		✓
Reduction of Window Galzing		✓
Insulation of Hot Water Heaters		✓

Lighting Type: Incandescent/FLOUR Heating System Type: Heat Pump
Cooling System: HEAT PUMP
Approximate Age: 5 yrs

New Additions: ______ Size: ______ Exposure: ____

ADDITIONAL COMMENTS

N/A - NOT Applicable.

PROJECT NO. 92008 DATE: DEC. 21

PROJECT: ESOS AT FORT A. P. HILL AND FORT BELVOIR

FIELD SURVEY FORM

BUILDING # 172 FORT A. P. HILL

SPACE ID COMM. CLUB - SPACE USAGE TAVERN

ENVELOPE CHARACTERISTICS (TYPE AND CONSTRUCTION):

WALLS LOGS.

SLATE EXPOSED ROOF/CEILING (TOP FLOOR ONLY) TOUNG & GROVE 6" x ? PLANKING

WINDOWS DBL GLAZED FIXED + SUN SCREEN

STORM WINDOWS

INTERNAL LOADS:

NUMBER OF PEOPLE BAL 24 + BSMT 32 + FIRST 36 = 92

LIGHTING: TYPE 1X4 FLOOR. NO. OF FIXTURES ______ WATTAGE ______

22 BLBS. TYPE CHAND. NO. OF FIXTURES 8LAMP WATTAGE 40 WATT

EQUIPMENT: LARGE T.V. BSMT. - ~~ICE MACH~~ BEER COOLER & ICE MACH.

COMPUTERS: NO. ______ WATTS (OR HEAT OUTPUT) ______

APPLIANCES: TYPE ______ NO. ______ WATTS ______

TYPE ______ NO. ______ WATTS ______

HOURS OF OPERATIONS:

WEEKDAYS 1130 - 100 TUES. - FRI.

SATURDAYS — BAR. 430 - 600

SUNDAYS

HOLIDAYS

THERMOSTAT SETTINGS 72-72 DIN. 72

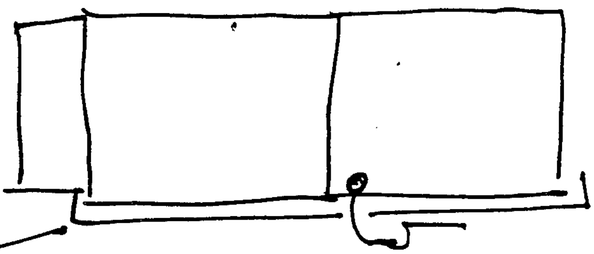
?

?

AH 3 - MEZZ LEVEL, CARRIER 40FQ9K6020

SER. # 4181A00107

240 - 208 1ϕ 60HZ.



DP.

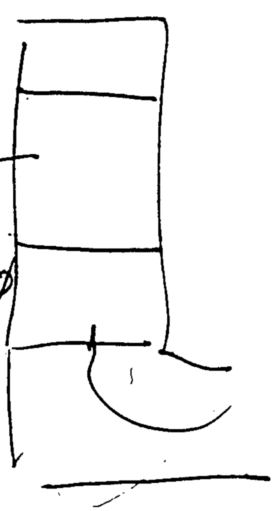
		240	208
CIRC.	SINGLE	L1 L2	L1 L2
HEAT AMPS		41.6	36.1
MIN. CIRC. AMP		57	50
MAX. OVER CURR.		60 FUSE	50

FAN 40FS160300301
SER. 3581HC0515 208/230
1/2HP. 3.5AMP. 1ϕ 60~

ATTIC

PROPANE TANK (KIT?

AH 1. CARRIER.. MOD. 40F0920080
SER. 4280H00544



40FS 220310
4681H0086
208/230 V.
1 HP. 6.9 1ϕ

240	208
SINGLE	
L1/L2	
39.6	34.4
58	52
60	60

BSMT.

3a

#2

SER. 1790E35242

MOD. 38YG060300 5 ton

28/230 8 SEER

RLA. 30.8

LRA 142.0

FAN FLA 1.4

MAX FUSE 60

#3

38RQ054330 5 4.5 ton 7-8 EER

SER. 5207711 MIN. CKT 46A MAX FUS 60

COMP. 230 1ϕ 6v RLA 35.3 LRA 150

FAN. 230V 1ϕ 23 .17 HP

1991E10055

#1

MOD. 38YG042310 4 ton 8 EER

COMP RLA 25.3 LRA 110.0

FAN. FLA 1.4

MAX FUSE 50

MAX. HACR CTR 50

Kitchen

CARRIER MOD. 38ENO48310 4 ton cooling only 6 EER

COMP. RLA. 28.8 125.0

ADD 1

MOT. 2.5

38.5

60

$6 \frac{Btu}{h \cdot w} \cdot \frac{1\ \text{ton}}{12{,}000\ \text{Btu/h}} \cdot \frac{1000}{k}$

$\frac{12}{6} \frac{kw}{\text{ton}} = 2.0$

HVAC EQUIPMENT (SERVING THE SPACE):

NAMEPLATE DATA ______________________________

____

____

NUMBER OF UNITS ______________________________

MISCELLANEOUS

BUILDING 174

RECOMENDATION	IMPLEMENTED	
	YES	NO
Night Setback		✓
Replacement of inefficient Light Fixtures	✓	
Ceiling Insulation	✓	
Wall Insulation	✓	
Wall Insulation (CMU wall)	✓	
Caulking and Weatherstripping	✓	
Storm Windows 1/2" AIR GAP THERMAL DOUBLE PANE		✓
Replace Inefficient Site Lighting	✓	
Overhead Door Replacement	N/A	N/A
Timer Switches (water pumps, etc.		✓
Water Heater Controls		✓
Solar Domestic Water Heater		✓
Trombe Wall Adaptation		✓
Conversion To Wood Stoker Boiler		✓
Photocell and Time Clock Controls for Lighting		✓
Replacement of Stand. Fluor. with High Eff. Light		✓
Selective Switching of Lights		✓
High Efficiency Motors		✓
Domestic Hot Water Circulating Pump Controls		✓
Insulated Damper Panels		✓
Elimination of Domestic Hot Water in Admin Blgs.		✓
Reduction of Window Galzing		✓
Insulation of Hot Water Heaters		✓

Lighting Type: INCANDESCENT/ FLUORESCENT.

Heating System Type: ______
Cooling System: ______
Approximate Age: 5 yrs

New Additions: ______ Size: ______ Exposure: ______

ADDITIONAL COMMENTS

PROJECT NO. 92008 DATE: DEC. 21

PROJECT: ESOS AT FORT A. P. HILL AND FORT BELVOIR

FIELD SURVEY FORM

BUILDING # 174 FORT A. P. HILL

SPACE ID - SPACE USAGE GUEST HOUSE

ENVELOPE CHARACTERISTICS (TYPE AND CONSTRUCTION):

WALLS BLOCK BSMT WD SIDING 1ST FL

ROOF/CEILING (TOP FLOOR ONLY) BLACK ASPHALT SHINGLE

WINDOWS

STORM WINDOWS

INTERNAL LOADS:

NUMBER OF PEOPLE 60% - 6 PROP

LIGHTING: REC. TYPE 2'x4' 4 LAMPS NO. OF FIXTURES 17 WATTAGE 40

(WATER PROBLEMS)

TYPE NO. OF FIXTURES WATTAGE

WINDOW IN GUEST RM DBL HUNG DBL GLAZED NO STORM EXT. WALLS 4"

EQUIPMENT: GRST RM (2) 2x4 (2) LAMPS LIT 40 W (SMALL REFRIG, MICRO WAVE, T.V. COFFEE MAKER)

BATH (1) INCON W/HEATER DIN. - (1) 2x2 FLOUR

COMPUTERS: + OUTSIDE (2) INC. NO. WATTS (OR HEAT OUTPUT)

APPLIANCES: TYPE NO. WATTS

ICE MACH IN LAUND. TYPE NO. WATTS

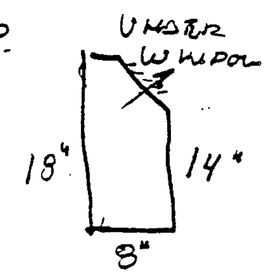
HOURS OF OPERATIONS: CARRIER THRU WALL H.P. HEAT & COOL OFF FAN ONLY HEAT COOL

WEEKDAYS 6 RM 42" x 14 x 8"

SATURDAYS

SUNDAYS

HOLIDAYS



THERM SETTINGS NOT SET 58°

Basement

OUTDOOR A.P. SER 3888E1 7299

MOD 38QNO48310 4 ton
6 EER

208/340 1φ 60~

CARRIER 253 MAX 197 MIN

COMPR. 208-230 1φ 60~

RLA 27.3

LRA 110.0

FAN 208-230

FLA 1.9

HP. 1/3

USA 60 CANADA 60

60

60

7

BUILDING 290

RECOMENDATION	IMPLEMENTED YES	IMPLEMENTED NO
Night Setback		✓
Replacement of inefficient Light Fixtures	✓	
Ceiling Insulation	✓	
Wall Insulation.	✓	
Wall Insulation (CMU wall)	✓	
Caulking and Weatherstripping		
Storm Windows 1/2" AG THERMAL Double Pane		✓
Replace Inefficient Site Lighting	✓	
Overhead Door Replacement	NA	NA
Timer Switches (water pumps, etc.		✓
Water Heater Controls		✓
Solar Domestic Water Heater		✓
Trombe Wall Adaptation		✓
Conversion To Wood Stoker Boiler		✓
Photocell and Time Clock Controls for Lighting		✓
Replacement of Stand. Fluor. with High Eff. Light		✓
Selective Switching of Lights		✓
High Efficiency Motors		✓
Domestic Hot Water Circulating Pump Controls		✓
Insulated Damper Panels		✓
Elimination of Domestic Hot Water in Admin Blgs.		✓
Reduction of Window Galzing		✓
Insulation of Hot Water Heaters		✓

Lighting Type: FLOUR. & INCAND.
Heating System Type: HEAT PUMP
Cooling System: ______
Approximate Age: 24rs

New Additions: ______ Size: ______ Exposure: ____

ADDITIONAL COMMENTS

N/A - NOT Applicable

290 TRAVIS LAKE

7- 60W

4

2 - 20W 2 ft Fl in box

WALKER CABIN

1248
5 2 - 4'-40W Fl

16 -

- No outside lights - Low pressure Sodium

BUILDING 710

RECOMENDATION	IMPLEMENTED YES	IMPLEMENTED NO
Night Setback	NA	NA
Replacement of inefficient Light Fixtures	✓	
Ceiling Insulation	NA	NA
Wall Insulation	NA	NA
Wall Insulation (CMU wall)	NA	NA
Caulking and Weatherstripping	NA	NA
Storm Windows	NA	NA
Replace Inefficient Site Lighting	NA	NA
Overhead Door Replacement	✓	
Timer Switches (water pumps, etc.	NA	NA
Water Heater Controls	NA	NA
Solar Domestic Water Heater	NA	NA
Trombe Wall Adaptation	NA	NA
Conversion To Wood Stoker Boiler	NA	NA
Photocell and Time Clock Controls for Lighting		✓
Replacement of Stand. Fluor. with High Eff. Light		✓
Selective Switching of Lights	NA	NA
High Efficiency Motors	NA	NA
Domestic Hot Water Circulating Pump Controls	NA	NA
Insulated Damper Panels	NA	NA
Elimination of Domestic Hot Water in Admin Blgs.	NA	NA
Reduction of Window Galzing	NA	NA
Insulation of Hot Water Heaters	NA	NA

Lighting Type: FL. - 8' Length

Heating System Type: None
Cooling System: None
Approximate Age: 2 yrs

New Additions: ______ Size: ______ Exposure: ______

ADDITIONAL COMMENTS

STORAGE FACILITY. Similar to BLG 1248 & HANGER (1203) - METAL STRUCTURE, SLAB ON GRADE WITH NO HEATING OR COOLING.

BUILDING 1203

RECOMENDATION	IMPLEMENTED YES	IMPLEMENTED NO
Night Setback	—NA—	
Replacement of inefficient Light Fixtures	✓	
Ceiling Insulation	—NA—	
Wall Insulation	—NA—	
Wall Insulation (CMU wall)	—NA—	
Caulking and Weatherstripping	—NA—	
Storm Windows	—NA—	
Replace Inefficient Site Lighting	—NA—	
Overhead Door Replacement	—NA—	
Timer Switches (water pumps, etc.	—NA—	
Water Heater Controls	—NA—	
Solar Domestic Water Heater	—NA—	
Trombe Wall Adaptation	—NA—	
Conversion To Wood Stoker Boiler	—NA—	
Photocell and Time Clock Controls for Lighting	—NA—	
Replacement of Stand. Fluor. with High Eff. Light	—NA—	
Selective Switching of Lights	—NA—	
High Efficiency Motors	—NA—	
Domestic Hot Water Circulating Pump Controls	—NA—	
Insulated Damper Panels	—NA—	
Elimination of Domestic Hot Water in Admin Blgs.	—NA—	
Reduction of Window Galzing	—NA—	
Insulation of Hot Water Heaters	—NA—	

Lighting Type: METAL HALIDE

Heating System Type: NONE
Cooling System: NONE
Approximate Age: 2yrs

New Additions: ______ Size: ______ Exposure: ______

ADDITIONAL COMMENTS

STORAGE (HANGER) FACILITY, NO Heating OR cooling.
At one time the building WAS USED FOR storing helicopters and
Repairing them.

FOR FLOOR PLANS SEE DRAWINGS

FIELD Survey - 8-26-

150W FLOODLIGHTS = 9 VA ANG BUILDING.

~~Building~~ 172 - 4-tube - 40W - delamp to 2 lamps

~80fc

6 Rooms

Intermittant USE

BLG 174

KITCHEN - 40W FL - 18

~ ~~.45~~ 50fc

Dinning - 90W Incandescent Sylvania Super Saver

56

LOWATT incandescent in BAR Area - High hat - compact flourescent

EXIT - INCANDESCENT - 2 - 25W

Ladies/Mens Room Basement - 2 - 40W - mostly tubular

BLG 1263 - 9 Metal Halid

Similar to 300W?

BLG 1248

BLG 710 - 16 - 8' 110W FLOURESCENT

No Heat, water, Not used only storage.

Similar to 1248

BUILDING 1241

RECOMENDATION	IMPLEMENTED	
	YES	NO
Night Setback		✓
Replacement of inefficient Light Fixtures	✓	
Ceiling Insulation	✓	
Wall Insulation	NA	
Wall Insulation (CMU wall)	✓	
Caulking and Weatherstripping		✓
Storm Windows	N/A	
Replace Inefficient Site Lighting	✓	
Overhead Door Replacement		✓
Timer Switches (water pumps, etc.		✓
Water Heater Controls		✓
Solar Domestic Water Heater		✓
Trombe Wall Adaptation		✓
Conversion To Wood Stoker Boiler		✓
Photocell and Time Clock Controls for Lighting		✓
Replacement of Stand. Fluor. with High Eff. Light		✓
Selective Switching of Lights		✓
High Efficiency Motors		✓
Domestic Hot Water Circulating Pump Controls		✓
Insulated Damper Panels		✓
Elimination of Domestic Hot Water in Admin Blgs.		✓
Reduction of Window Galzing		✓
Insulation of Hot Water Heaters		✓

Lighting Type: FL-40W

Heating System Type: elec resistance.
Cooling System: —
Approximate Age: 2yr

New Additions:

Size:

Exposure:

ADDITIONAL COMMENTS

small Room Heater (cabinet heater).

Field Survey 8-19-93

BUILDING 1242

RECOMENDATION	IMPLEMENTED YES	IMPLEMENTED NO
Night Setback		✓
Replacement of inefficient Light Fixtures	✓	
Ceiling Insulation	✓	
Wall Insulation	NA	
Wall Insulation (CMU wall)	✓	
Caulking and Weatherstripping		✓
Storm Windows		✓
Replace Inefficient Site Lighting	✓	
Overhead Door Replacement		✓
Timer Switches (water pumps, etc.		✓
Water Heater Controls		✓
Solar Domestic Water Heater		✓
Trombe Wall Adaptation		✓
Conversion To Wood Stoker Boiler		✓
Photocell and Time Clock Controls for Lighting		✓
Replacement of Stand. Fluor. with High Eff. Light		✓
Selective Switching of Lights		✓
High Efficiency Motors		✓
Domestic Hot Water Circulating Pump Controls		✓
Insulated Damper Panels		✓
Elimination of Domestic Hot Water in Admin Blgs.		✓
Reduction of Window Galzing		✓
Insulation of Hot Water Heaters		✓

Lighting Type: FL 40W

Heating System Type: CABinet Heater

Cooling System: —

Approximate Age: 2 yrs

New Additions: _____ Size: _____ Exposure: _____

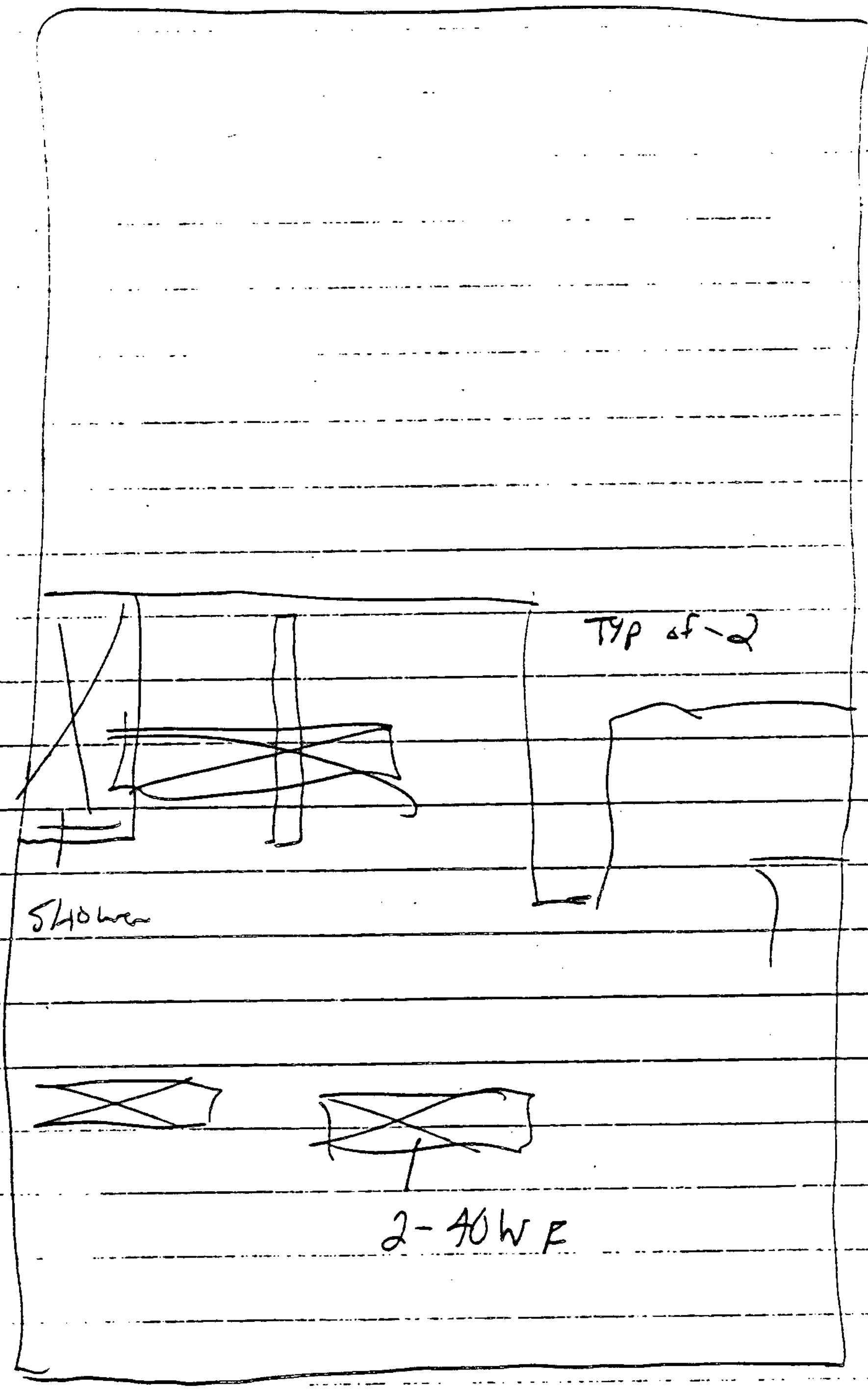
ADDITIONAL COMMENTS

Small Room Heater

Field Survey Notes

1242 – LATRINE 7:00 am – 430 pm

1241 – TYPICAL



PROJECT NO. 92008 DATE: DEC. 21, 1993

PROJECT: ESOS AT FORT A. P. HILL AND FORT BELVOIR

FIELD SURVEY FORM

BUILDING # 1220 FORT A. P. HILL

SPACE ID ENGINEERING SPACE USAGE ADMIN.

ENVELOPE CHARACTERISTICS (TYPE AND CONSTRUCTION):

WALLS ORIG. - BLOCK - ADDITION SIDING

ROOF/CEILING (TOP FLOOR ONLY) ASPHALT SHING. RIDGE VENT GABLE END VENTS

WINDOWS SINGLE DROP CLG 2x4 w/ PLAST. 8' @ 10'

STORM WINDOWS YES

ORIG. 29

DBL INSUL

INTERNAL LOADS: 6" INSUL. ON TOP OF CLG

NUMBER OF PEOPLE

LIGHTING: TYPE FLOUR 2x4 NO. OF FIXTURES WATTAGE

TYPE NO. OF FIXTURES WATTAGE

EQUIPMENT:

COMPUTERS: NO. P.C. IN EA OFF WATTS (OR HEAT OUTPUT)

APPLIANCES: TYPE NO. WATTS

MICRO. RANGE REF. COFF. TYPE NO. WATTS

HOURS OF OPERATIONS:

WEEKDAYS 800 : 430

SATURDAYS

SUNDAYS

HOLIDAYS

THERMOS. SETTINGS SRT 80 71 72 SRT 11 76 2 EA

16

HVAC EQUIPMENT (SERVING THE SPACE):

NAMEPLATE DATA ______________________________

____

____

NUMBER OF UNITS ______________________________

MISCELLANEOUS

PROJECT NO. 92008 DATE: ____________________

PROJECT: ESOS AT FORT A. P. HILL AND FORT BELVOIR

FIELD SURVEY FORM

BUILDING # 1237 FORT A. P. HILL

SPACE ID ____________________ SPACE USAGE WAREHOUSE

ENVELOPE CHARACTERISTICS (TYPE AND CONSTRUCTION):

WALLS ____________________

ROOF/CEILING (TOP FLOOR ONLY) ____________________

WINDOWS ____________________

STORM WINDOWS ____________________

INTERNAL LOADS:

METAL SIDE

NUMBER OF PEOPLE 3-4

NO INSUL

LIGHTING: TYPE FLUR. NO. OF FIXTURES ________ WATTAGE ________

TYPE ________ NO. OF FIXTURES ________ WATTAGE ________

15,000 ft

EQUIPMENT:

COMPUTERS: NO. ________ WATTS (OR HEAT OUTPUT) ________

APPLIANCES: TYPE ________ NO. ________ WATTS ________

TYPE ________ NO. ________ WATTS ________

HOURS OF OPERATIONS:

WEEKDAYS ____________________

SATURDAYS ____________________

SUNDAYS ____________________

HOLIDAYS ____________________

YEAR ROUND

HVAC EQUIPMENT (SERVING THE SPACE):

NAMEPLATE DATA ____________________

____

____

NUMBER OF UNITS ____________________

MISCELLANEOUS

PROJECT NO. 92008 DATE: 11-5-92

PROJECT: ESOS AT FORT A. P. HILL AND FORT BELVOIR

Daniel Schwoetz

FIELD SURVEY FORM

BUILDING # 1243 (150x50) FORT A. P. HILL

SPACE ID FABRIC SHOP 50x50 SPACE USAGE GARAGE

ENVELOPE CHARACTERISTICS (TYPE AND CONSTRUCTION):

WALLS Metal, Concrete

ROOF/CEILING (TOP FLOOR ONLY) Metal pitch

WINDOWS ~~None~~ Clear Fiberglass panel in Roof

STORM WINDOWS None

INTERNAL LOADS:

NUMBER OF PEOPLE 1 perm 2 temp

LIGHTING: TYPE FL NO. OF FIXTURES 21 WATTAGE 40

TYPE F NO. OF FIXTURES ____ WATTAGE ____

EQUIPMENT:

COMPUTERS: NO. Sewing Mach WATTS (OR HEAT OUTPUT) ____

APPLIANCES: TYPE ____ NO. ____ WATTS ____

TYPE ____ NO. ____ WATTS ____

HOURS OF OPERATIONS:

WEEKDAYS M-F, 8-4:30

SATURDAYS ____

SUNDAYS ____

HOLIDAYS ____

HVAC EQUIPMENT (SERVING THE SPACE):

NAMEPLATE DATA UFO 105, SN: 0986-2130, 105,000 input [illegible]/hr

output 70,000 BTU, #2 oil, .65 GPH, 1/4 hp 70-100°F

NUMBER OF UNITS

MISCELLANEOUS

BUILDING 1252

RECOMENDATION	IMPLEMENTED	
	YES	NO
Night Setback		✓
Replacement of inefficient Light Fixtures	✓	
Ceiling Insulation	✓	
Wall Insulation	✓	
Wall Insulation (CMU wall)	— N/A	—
Caulking and Weatherstripping		✓
Storm Windows		✓
Replace Inefficient Site Lighting		✓
Overhead Door Replacement		✓
Timer Switches (water pumps, etc.		✓
Water Heater Controls		✓
Solar Domestic Water Heater		✓
Trombe Wall Adaptation		✓
Conversion To Wood Stoker Boiler		✓
Photocell and Time Clock Controls for Lighting		✓
Replacement of Stand. Fluor. with High Eff. Light		✓
Selective Switching of Lights		✓
High Efficiency Motors		✓
Domestic Hot Water Circulating Pump Controls		✓
Insulated Damper Panels		✓
Elimination of Domestic Hot Water in Admin Blgs.		✓
Reduction of Window Galzing		✓
Insulation of Hot Water Heaters		✓

Lighting Type: FL

Heating System Type: Heat Pump
Cooling System: Heat Pump
Approximate Age: 27 yr

New Additions: ______ Size: ______ Exposure: ____

ADDITIONAL COMMENTS

HEAT PUMPS

PROJECT NO. 92008 DATE: NOV. 5, 1992

PROJECT: ESOS AT FORT A. P. HILL AND FORT BELVOIR

FIELD SURVEY FORM

BUILDING # 1252 FORT A. P. HILL 5000#

SPACE ID TRAINING SPACE USAGE TRAINING, DIVISION 2500± / 2500± WAREHOUSE / OFFICE

ENVELOPE CHARACTERISTICS (TYPE AND CONSTRUCTION): EXP. ROOF / DROP CLG. (1) ROLL UP DOOR 2X4

WALLS

ROOF/CEILING (TOP FLOOR ONLY)

WINDOWS MINIMUM DBL GLAZED SINGLE CASEMENT 1' X 5' (5) TOTAL

STORM WINDOWS N/A

INTERNAL LOADS:

NUMBER OF PEOPLE 7 FULLTIME PEOPLE 15 — 3 YEARS OLD

LIGHTING: OFF TYPE FLOUR. NO. OF FIXTURES 13 WATTAGE 4 LAMP

WAREHOUSE ~~TYPE~~ NO. OF FIXTURES 20 WATTAGE 4 LAMP

EQUIPMENT:

MENS ROOM 2 LAV. 1 UR.
WOM. 1 LAV. + 1 WC

COMPUTERS: NO. 3 PC's WATTS (OR HEAT OUTPUT)

APPLIANCES: TYPE 4 BURN. RANGE OVEN NO. WATTS

REF, COFFEEMAK MICROWAVE

TYPE NO. WATTS

HOURS OF OPERATIONS:

WEEKDAYS 730-500

SATURDAYS 800-430

SUNDAYS "

HOLIDAYS

533-3540

HVAC EQUIPMENT (SERVING THE SPACE):

NAMEPLATE DATA ______________________________

____

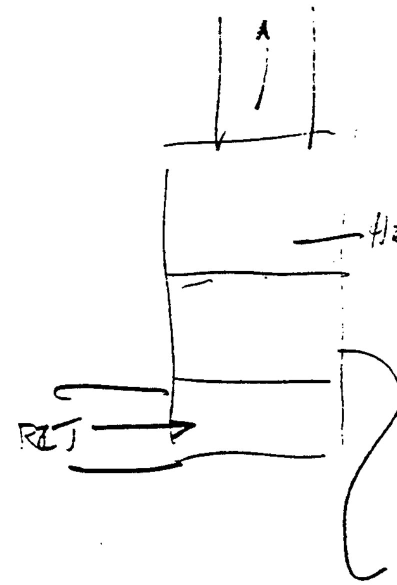
____

NUMBER OF UNITS ______________________________

MISCELLANEOUS

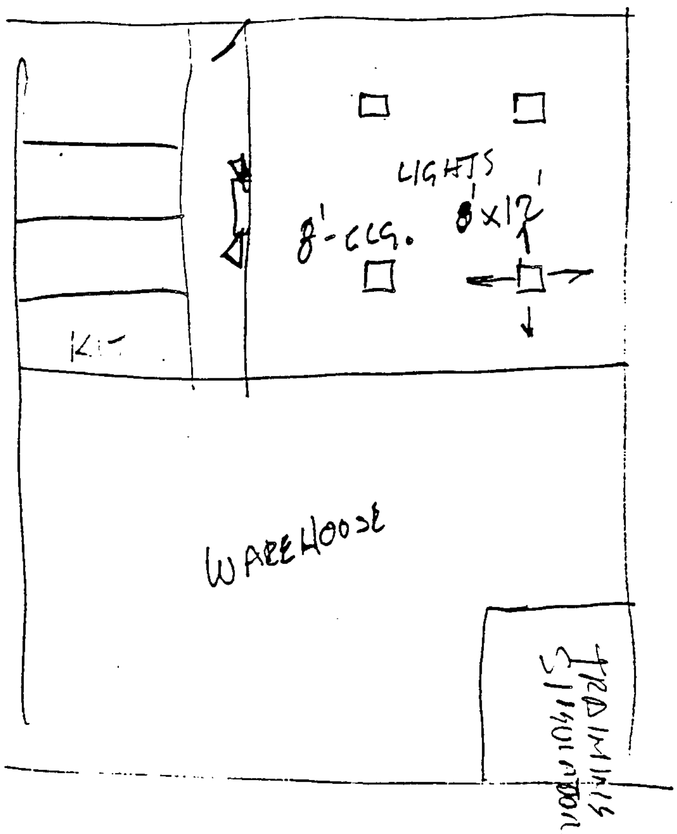
WATER HTR
4.5/4.5

COMFORTMAKER
HEATPUMP

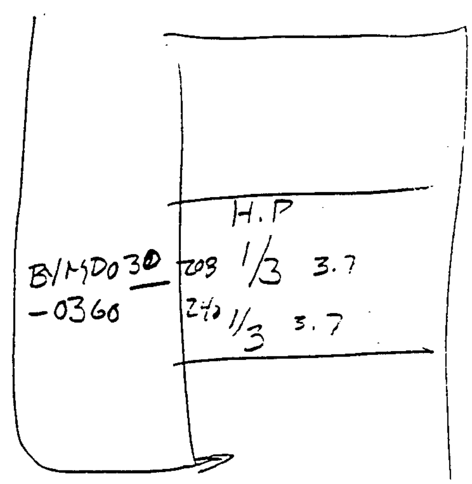


INSTALLED
DEBC020G 3/
AMPS KW
240 40.0
HEATER 240 40.0
208 34.6 7.2
208 34.6

BMC G02 0A
AIR HANDLER
H.P. FLA
240 .75 6.8
208



COMFORTMAKER

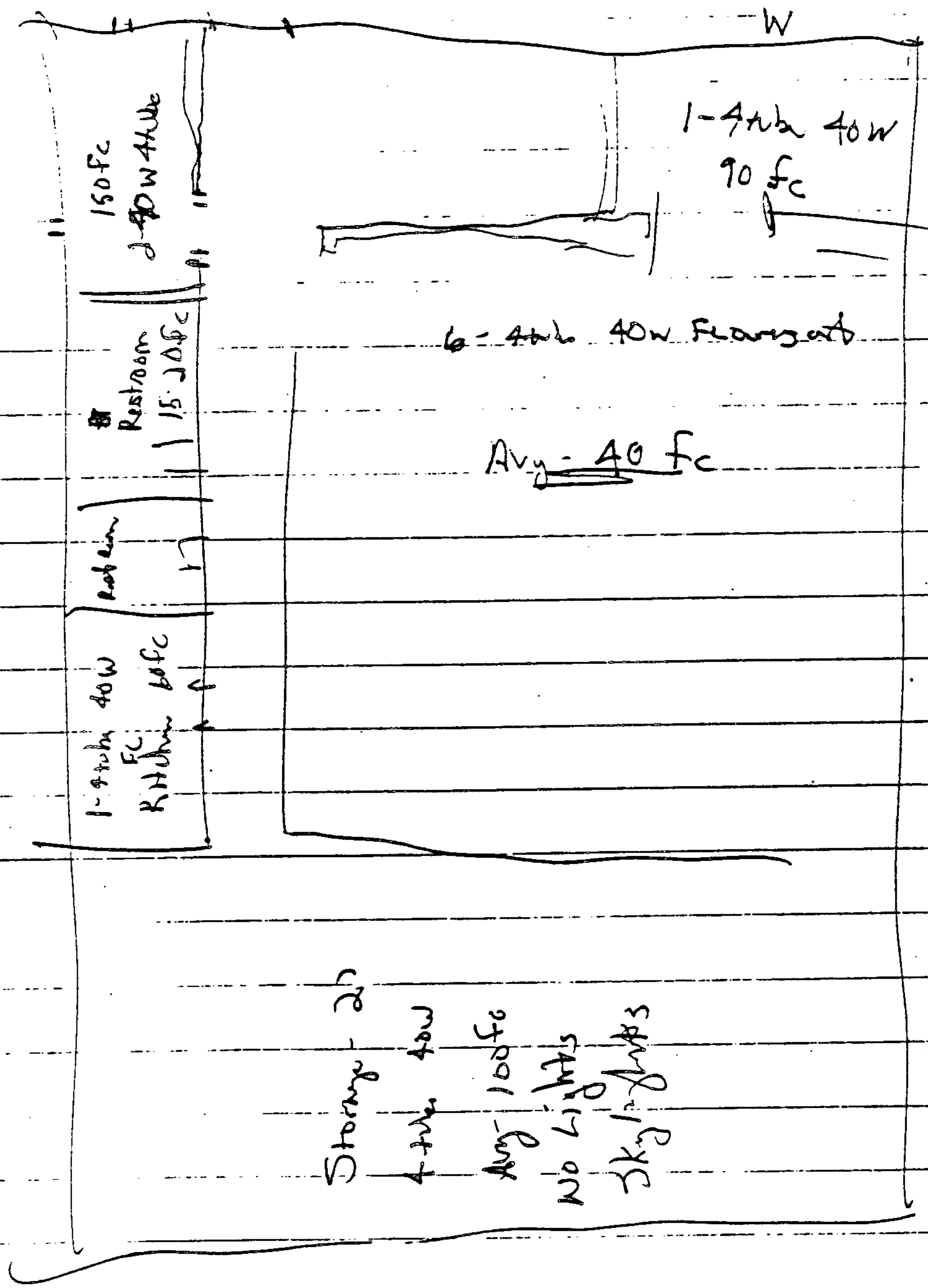


FIELD Survey
8-26-93

1252

6 - 4- 40W Flourescent

Avg 40Fc



Field Survey 8-19-93

BUILDING 1253

RECOMENDATION	IMPLEMENTED	
	YES	NO
Night Setback		✓
Replacement of inefficient Light Fixtures	✓	
Ceiling Insulation	✓	
Wall Insulation	✓	
Wall Insulation (CMU wall)	— NA	—
Caulking and Weatherstripping		✓
Storm Windows		✓
Replace Inefficient Site Lighting		✓
Overhead Door Replacement		✓
Timer Switches (water pumps, etc.		✓
Water Heater Controls		✓
Solar Domestic Water Heater		✓
Trombe Wall Adaptation		✓
Conversion To Wood Stoker Boiler		✓
Photocell and Time Clock Controls for Lighting		✓
Replacement of Stand. Fluor. with High Eff. Light		✓
Selective Switching of Lights		✓
High Efficiency Motors		✓
Domestic Hot Water Circulating Pump Controls		✓
Insulated Damper Panels		✓
Elimination of Domestic Hot Water in Admin Blgs.		✓
Reduction of Window Galzing		✓
Insulation of Hot Water Heaters		✓

Lighting Type: FL

Heating System Type: Heat Pump
Cooling System: Heat Pump
Approximate Age: 2 yrs

New Additions: ______ Size: ______ Exposure: ______

ADDITIONAL COMMENTS

033-3279 410-334 374 2/10 — 410 RANGE ELECTR...

PROJECT NO. 92008

DATE: NOV 5, 1992

PROJECT: ESOS AT FORT A. P. HILL AND FORT BELVOIR

FIELD SURVEY FORM

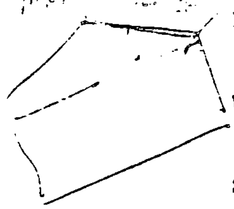
BUILDING # 1253 FORT A. P. HILL

SPACE ID 1 SPACE USAGE RANGE CONTROL - 4 YEARS

ENVELOPE CHARACTERISTICS (TYPE AND CONSTRUCTION):

WALLS 2' - 2' ...

METAL BLDG.



ROOF/CEILING (TOP FLOOR ONLY) ____

WINDOWS 1' V 5 ACROSS THE FRONT ...

STORM WINDOWS NO

INTERNAL LOADS:

NUMBER OF PEOPLE 8 FULL UP TO + 50 IN BRIEFING / TRAIN SEC

LIGHTING: TYPE FLOUR NO. OF FIXTURES ____ WATTAGE ____

TYPE ____ NO. OF FIXTURES ____ WATTAGE ____

EQUIPMENT:

COMPUTERS: NO. 1 WATTS (OR HEAT OUTPUT) 1500

APPLIANCES: RANGE REF. TYPE ____ NO. ____ WATTS ____

TYPE ____ NO. ____ WATTS ____

HOURS OF OPERATIONS:

AIR COMPRESSOR

WEEKDAYS 600 - 1000

SATURDAYS YES 800-430

SUNDAYS YES

HOLIDAYS ____

HVAC EQUIPMENT (SERVING THE SPACE):

NAMEPLATE DATA ______________________________

____

____

NUMBER OF UNITS ______________________________

MISCELLANEOUS

CARRIER H.P. OUTDOOR

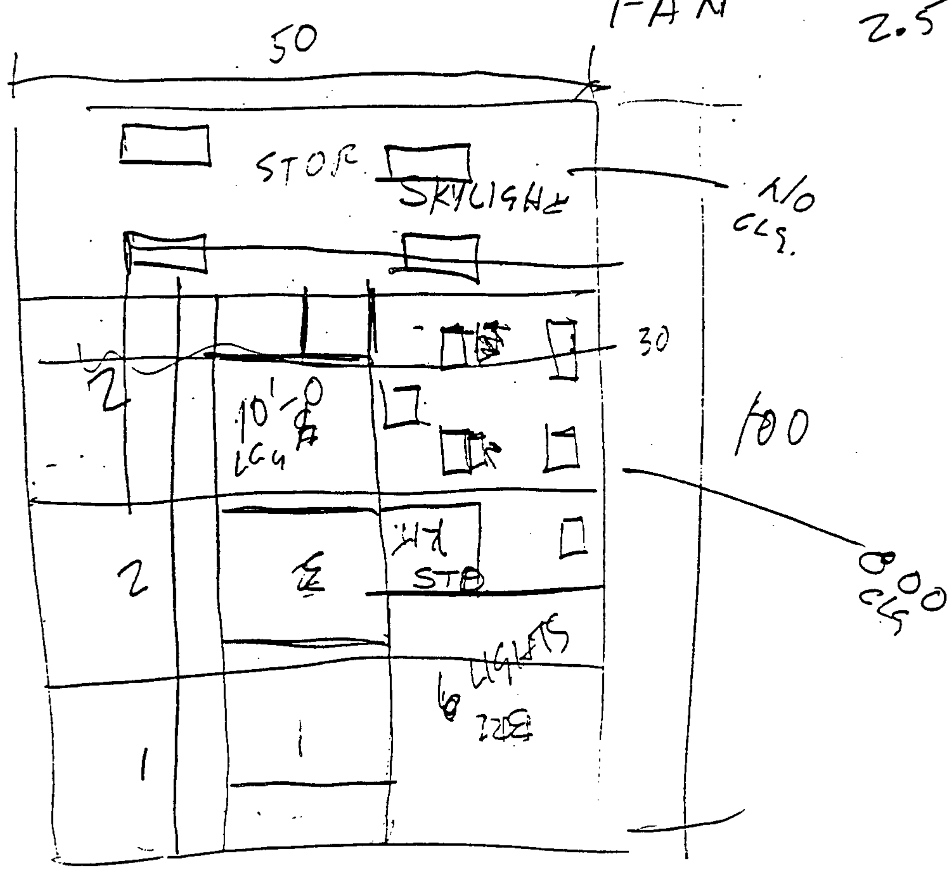
38 QN036300 SM - 3 ton

6 EER

WATER HTR
4.5 | 4.5 KW.
220-240

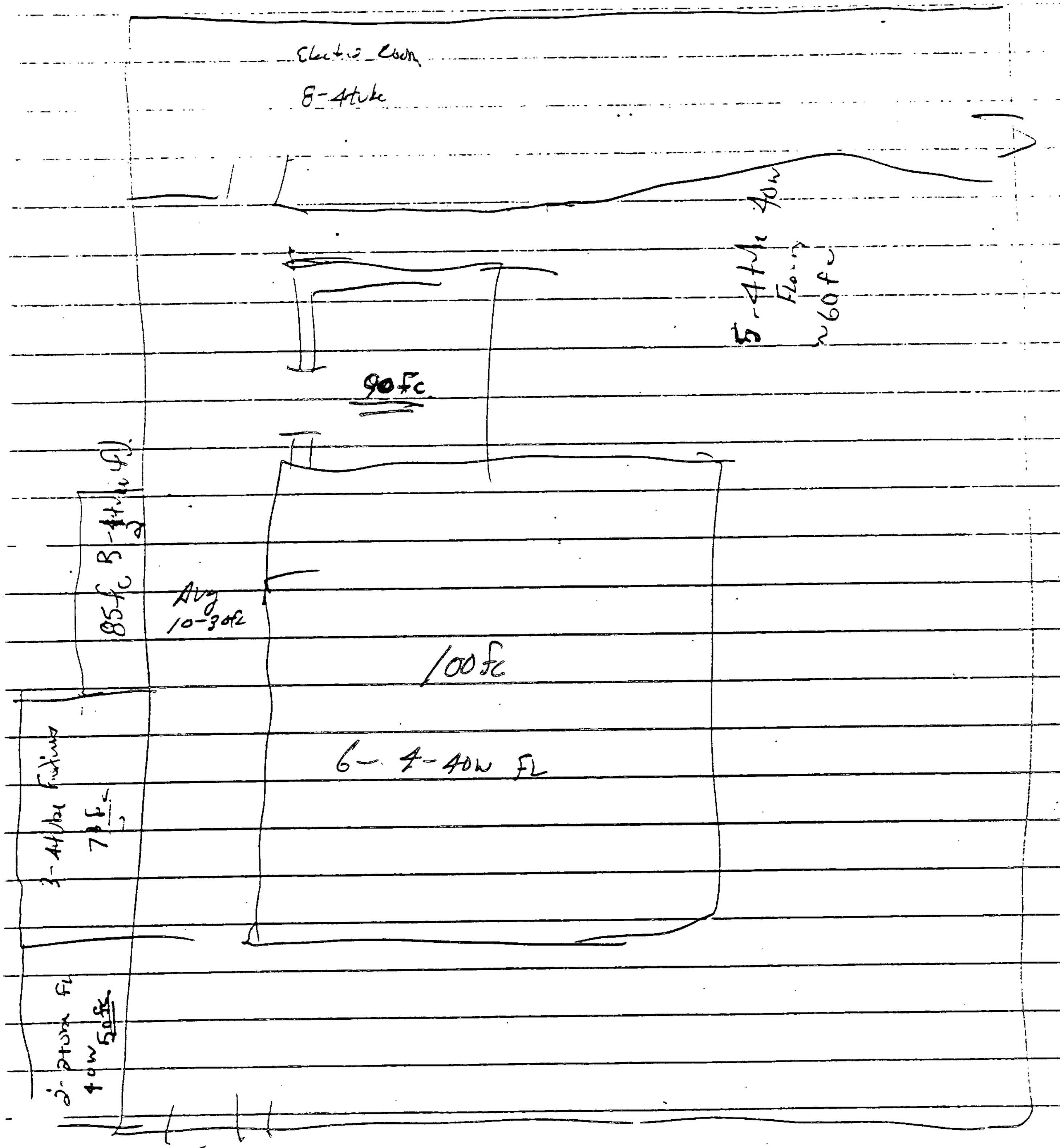
(2) COMP

	RLA	LRA
COMP	20.0	92.0
FAN	2.5	



Field Survey
8-26-03

1253 8-436 2.5W



October 13. 1992

Directorate of Engineering
and Housing

TO WHOM IT MAY CONCERN;

The persons in possession of this letter are performing an energy opportunity survey at Fort A.P. Hill. The study is being conducted by Engineering Applications Consultants under contract number DACA 31-89-C-0198. If you have any questions or concerns please contact the Environmental Office (Terry Banks or John Phillips) at ext. 255.

Sincerely,

Kenneth D. Comfort

for G. M. Tribble, Jr.
Directorate of Engineering
and Housing

John Solarczyk

Point of Contacts

*172 Jerry Schroeder
179 BOILER ROOM ✓
188 Paul Daucher
189 (266) (633-8266) comm

236 Paul Daucher
269
290 Stephen Devereux Bldg 106 Ext 219

311 BOILER ROOM ✓
384 Paul Daucher

413
415 Paul Daucher

820 BOILER ROOM ✓
821 BOILER ROOM ✓

*1237 Jimmie Randle WAREHOUSE
1248 Norman Fenerty (Bldg 1290) TENNIS
*1252 Joe Medley TRAIN
*1253 Joe Medley RANGES

1335 - Paul Daucher
*1336 - DOD
1337 - Paul Daucher
1350
1356 Family Housing Mr. Darden (142)

1432 - Paul Daucher

1528
1559 DOL-Ed Foreman (143)
1561
1562 Paul Daucher

1610
1612 Paul Daucher

Engineering Applications Consultants, P.C.

9004-B Crownwood Ct., Burke, Virginia 22015-1679; Phone (703) 978-0923; FAX: (703) 978-7331

FIELD SURVEY REPORT

Project: Energy Savings Opportunity Survey, Fort A.P. Hill, Virginia

Contract (Client Project) No.: DACA 31-89-C-0198 EAC Project No.: 92008.00

Place: FORT A.P. HILL Date: 10/26/92

Purpose: FIELD SURVEY

1. Completed a survey of 10 out of 11 buildings. The following buildings were completely surveyed to determine if any additions, alterations, remodeling, etc. was completed after FY1980: 101, 126, 214, 311, 1528, 179, 820, 821.

2. The following mechanical rooms were not accessible: 311, 820, 821, 179. The mechanical rooms in these buildings house the boilers, A/C Units and hotwater heaters.

3. A complete survey for building 1528 needs to be completed.

4. Building 313 is now a firehouse and an addition was added in 1988-89. The addition houses firemen fulltime and has its own heat pump system and electric hot water tank. The firehouse is having its oil fired boiler replaced in 1992.

5. Buildings 101 and 126 have undergone major renovations in 1986 and 1988. Each building had additional insulation added, new aluminum siding, and new heat pump systems. Building 126 had a new roof installed at the time of renovation. Building 101 is currently under contract for replacement of it's roof.

92008B\meetings\102192

BUILDING 101

RECOMENDATION	IMPLEMENTED	
	YES	NO
Night Setback		✓
Replacement of inefficient Light Fixtures		✓
Ceiling Insulation	✓	
Wall Insulation	✓	
Wall Insulation (CMU wall)		
Caulking and Weatherstripping	✓	
Storm Windows	✓	
Replace Inefficient Site Lighting		
Overhead Door Replacement		
Timer Switches (water pumps, etc.	✓	
Water Heater Controls	✓	
Solar Domestic Water Heater		✓
Trombe Wall Adaptation		✓
Conversion To Wood Stoker Boiler	✓	
Photocell and Time Clock Controls for Lighting	✓	
Replacement of Stand. Fluor. with High Eff. Light		✓
Selective Switching of Lights		✓
High Efficiency Motors		✓
Domestic Hot Water Circulating Pump Controls		✓
Insulated Damper Panels		
Elimination of Domestic Hot Water in Admin Blgs.		
Reduction of Window Galzing		
Insulation of Hot Water Heaters		

Lighting Type: ____________

Heating System Type: Heat pump (87-90)
Cooling System: ____________
Approximate Age: ________

New Additions: ____________ Size: ____________ Exposure: ____

ADDITIONAL COMMENTS

Al Siding - Renovation - 1-[illegible]" poly Styrofoam, 3/4" Wood, ~~[illegible]~~ ? 1 1/2 panel [illegible]

New Roof - out for contract

Crawl space - No floor ins, Carpet on interior

(R-19 Batt in Ceiling/Attic)

Rappahannock Load Management
model Y95000-1
Ser : 29196
VAC - 240
Amp · .025

TRANE Weathertron Heat Pump 3/89

CPR Motor - 38.0 RLA
200-230 V
60 Hz
200 LRA

ID Motor - 5 FLA, 200-230V, 60 Hz 1.5 hp
OD Motor 3.8 FLA, 200-230, 60 Hz

Ref - 22 23 lbs, 4 oz.

Psi - 350 high, 150 Low MIN CKT AMPS - 62

Model: BWC120C300JA
Serial: D121 82722

Windows - 32×36 (typ.), 1/2" AG W/STORM
Doors - ~~3~~ x 7

BUILDING 126 Jack Tignor 804-633-8201 (5207)

RECOMENDATION	IMPLEMENTED	
	YES	NO
Night Setback		✓
Replacement of inefficient Light Fixtures	✓	
Ceiling Insulation R-19	✓	
Wall Insulation ~~[illegible]~~ See plans	✓	
~~Wall Insulation (CMU wall)~~		
Caulking and Weatherstripping	✓	
Storm Windows (interior	✓	✓
Replace Inefficient Site Lighti~~ng~~		✓
~~Overhead Door Replacement~~		✓
~~Timer Switches (water pumps, etc)~~		
Water Heater Controls	✓	
Solar Domestic Water Heater		✓
Trombe Wall Adaptation		✓
Conversion To Wood Stoker Boiler		✓
Photocell and Time Clock Controls for Lighting		✓
Replacement of Stand. Fluor. with High Eff. Light		✓
Selective Switching of Lights	✓	
High Efficiency Motors		✓
Domestic Hot Water Circulating Pump Controls		✓
Insulated Damper Panels		✓
Elimination of Domestic Hot Water in Admin Blgs.		✓
Reduction of Window Galzing		✓
Insulation of Hot Water Heaters		✓

Lighting Type:______ Heating System Type:______
Cooling System:______
Approximate Age:______

New Additions:______ Size:______ Exposure:____

ADDITIONAL COMMENTS

Renovation - 1986 Windows - 3/8" - 1/4" ~~[illegible]~~ SAG. W/ INTERIOR STORM

R19 Ceiling
1" Styrofoam outside
AL Siding

BRK RM~ Stove, Ref, Micro., sink,
Soda machine

2 - **CARRIER**

	230V, 1 Ph, 60 Hz
Compressor	230V, 1 Ø, 60Hz, 28.8 RLA, 130 LRA
FAN MOTOR	208-230V, 1 Ø, 60Hz, 2.5 FLA

R-22 13 lbs, 300 Hpsi, 150 LPSI
MIN CKT AMPS - 38.5
Model: 38QN060300
Serial: T424676

2 - **Ceiling Hung AHU**

model 40GHD60300
Serial X461398
208/230 - 1Ø/60Hz
motor .75 hp
.56 KW
5.6 FLA

R22, 2.0" H_2O Test static

(4 x 3 x 2)

CARRIER HEAT PUMP

model: 50QH008510 SERIAL: 2684614700 | R22 ~~[illegible]~~ 300lbs

Comp (2) 208-~~230~~ 230V, 3 Ø, 60Hz, 16.5 RLA, 80 LRA
FAN (2) 208-230V, 1 Ø, 60 Hz, 2.9 FLA, 1/4 hp, .19 KW
INDOOR FAN: 208-230V, 3Ø, 60Hz, 4.8 FLA, 1 hp, .75 KW

.25" TOT. SP.

Accessory heaters

				FLA	Min CKT Amps	max CKT Amps
88EK0093EB00	208/240	3Ø	60Hz	20-23	72-79	80/80
88EK0158EB00	"	"	"	33-38	93-99	90/90
88EK0158EB00	"	"	"	66-76	135-148	125/150

Model 50QH008510

25cm Listed UL.

BUILDING 174 · DINNING/BRICK : DEBORAH BRIGHT 804 653-8234

RECOMENDATION	IMPLEMENTED YES	IMPLEMENTED NO
Night Setback		✓
Replacement of inefficient Light Fixtures		
Ceiling Insulation		✓
Wall Insulation		✓
Wall Insulation (CMU wall)		
Caulking and Weatherstripping	✓	
Storm Windows		
Replace Inefficient Site Lighting		✓
Overhead Door Replacement		✓
Timer Switches (water pumps, etc.		
Water Heater Controls		
Solar Domestic Water Heater		✓
Trombe Wall Adaptation		✓
Conversion To Wood Stoker Boiler		✓
Photocell and Time Clock Controls for Lighting		
Replacement of Stand. Fluor. with High Eff. Light		✓
Selective Switching of Lights		✓
High Efficiency Motors		✓
Domestic Hot Water Circulating Pump Controls	✓	
Insulated Damper Panels		✓
Elimination of Domestic Hot Water in Admin Blgs.		✓
Reduction of Window Galzing		
Insulation of Hot Water Heaters		✓

Lighting Type: FL

Heating System Type: ______
Cooling System: ______
Approximate Age: ______

New Additions: ______ Size: ______ Exposure: ______

ADDITIONAL COMMENTS

— Sept 90 Dining Closed
— Dining being Convert. to Gym
— Caulked & Repaired interior, carpet installed

Windows - Double pane 1/2" AG

Burnham (HEAT)

M: PF 597

SN: 7582294

OUTPUT	STEAM	STEAM MBH	WATER MBH	GAS MBH
1116	3488 (#42)	837.2	970.4	1372

steam 15psi

H_2O 50psi

160F

Hot water ~ 5' dia

6'6" Length

~~Bryan~~ Bryan - Hot water

model D-650 4.5gal/Hr

SN: 45626

1976

30lb H_2O

BUILDING 211   Frank Wagner

RECOMENDATION	IMPLEMENTED	
	YES	NO
Night Setback		✓
Replacement of inefficient Light Fixtures		
Ceiling Insulation		✓
Wall Insulation		✓
Wall Insulation (CMU wall)		✓
Caulking and Weatherstripping		✓
Storm Windows		✓
Replace Inefficient Site Lighting		✓
Overhead Door Replacement		✓
Timer Switches (water pumps, etc.		✓
Water Heater Controls	✓	
Solar Domestic Water Heater		✓
Trombe Wall Adaptation		✓
Conversion To Wood Stoker Boiler		✓
Photocell and Time Clock Controls for Lighting		✓
Replacement of Stand. Fluor. with High Eff. Light		✓
Selective Switching of Lights		✓
High Efficiency Motors		✓
Domestic Hot Water Circulating Pump Controls		✓
Insulated Damper Panels		✓
Elimination of Domestic Hot Water in Admin Blgs.		✓
Reduction of Window Galzing		✓
Insulation of Hot Water Heaters		✓

Lighting Type:____________   Heating System Type:____________
Cooling System:____________
Approximate Age:________

New Additions:____________   Size:____________   Exposure:____

ADDITIONAL COMMENTS

- All tin Structure

~~Fe~~ Steel Framing w/ Gyp inside Finish

Hot water Heater

Smith ~~Permaglas~~ Permaglass
2 element 4500 ea
120 gal

Wondaire Furnace - warm air

model: HO 225
Capacity: 2.00
SN: 17658

3 GPH ~~Boiler~~ Burner
#2 oil

369

BUILDING 313 Jack Marmaduck 623-8267

RECOMENDATION	IMPLEMENTED YES	IMPLEMENTED NO
Night Setback		✓
Replacement of inefficient Light Fixtures		✓
Ceiling Insulation		
Wall Insulation	✓	
Wall Insulation (CMU wall) inter sw	✓	
Caulking and Weatherstripping		✓
Storm Windows		
Replace Inefficient Site Lighting		
Overhead Door Replacement		✓
Timer Switches (water pumps, etc.		
Water Heater Controls		
Solar Domestic Water Heater		
Trombe Wall Adaptation		
Conversion To Wood Stoker Boiler		
Photocell and Time Clock Controls for Lighting		
Replacement of Stand. Fluor. with High Eff. Light		
Selective Switching of Lights		
High Efficiency Motors		
Domestic Hot Water Circulating Pump Controls		
Insulated Damper Panels		
Elimination of Domestic Hot Water in Admin Blgs.		
Reduction of Window Galzing		
Insulation of Hot Water Heaters		

Lighting Type:______

Heating System Type:______
Cooling System:______
Approximate Age:______

New Additions: no - 88-89 Size:______ Exposure:____

ADDITIONAL COMMENTS

Replacing furnace Fall-Spring Replace boiler

JACKSON & CHURCH

model - SDF 50 FU   625000 BTU   Burner
Serial - 893-223   EH MP 98
5350 cfm to 9100 cfm   #2 oil
ΔT = 50 to 85   4.5 GPH
                                                              .25" Ext. S.P.

Blower   1.5 hp 110V, 16.4A, 1Ø, 60Hz

Burner motor 1/4 hp 1.10V, 3.6A, 1Ø, 60Hz
Upright Position

ADDITION

Carrier

outdoor

model 38BQ008530   R22, 300psi High, 150psi Low
Serial 1798630856
Comp   208-230, 3Ø, 60Hz 38.5RLA, 137LRA, .31 NEC, .23 KW

80 GAL, 2-4500W elements, STATE - 510E

AC unit 6/88
MODEL 40BA-009-300   R-22   300 psi
Serial T886400
Indoor - 115/200-230   1 Ø 60Hz   16/8.2FLA   1hp   .746KW

HEATERS

40BA900040	208-230	1Ø	60Hz	40.8
40BA900080	208-230	3Ø	"	23.6
40BA900090	460V	3Ø	"	11.9

.2" Ext S.P.

BUILDING S2C

RECOMENDATION	IMPLEMENTED	
	YES	NO
Night Setback		✓
Replacement of inefficient Light Fixtures		✓
Ceiling Insulation		✓
Wall Insulation		✓
Wall Insulation (CMU wall)		✓
Caulking and Weatherstripping		✓
Storm Windows		✓
Replace Inefficient Site Lighting		✓
Overhead Door Replacement		✓
Timer Switches (water pumps, etc.		✓
Water Heater Controls		✓
Solar Domestic Water Heater		✓
Trombe Wall Adaptation		✓
Conversion To Wood Stoker Boiler		✓
Photocell and Time Clock Controls for Lighting		✓
Replacement of Stand. Fluor. with High Eff. Light		✓
Selective Switching of Lights		✓
High Efficiency Motors		✓
Domestic Hot Water Circulating Pump Controls		✓
Insulated Damper Panels		✓
Elimination of Domestic Hot Water in Admin Blgs.		✓
Reduction of Window Galzing		✓
Insulation of Hot Water Heaters		✓

Lighting Type:______________ Heating System Type:______________

Cooling System:______________

Approximate Age:________

New Additions:______________ Size:______________ Exposure:____

ADDITIONAL COMMENTS

CENTRALAIRE - AHU

model HV 118 Serial - 27930

HV-2

FAN MOTOR - 2Hp 3Φ 60 Hz

208V, 1730 RPM

7.8 Amps Class B

Code J

ID P14610/M-AU

AHU: CENTRALAIRE

model: HV 115

Serial: 27931

Hot water TANK , 1" FIBERGLASS insulation

2' Dia x 6' Length ~180°F

~~Cleaver~~ Cleaver BROOKS Package Boiler

model: CBH193-80 15psi

Serial L-47423

INPUT 3 347 000 Btu/HR 230 GPH

Date 5/15/60

#2 oil

BUILDING 821

RECOMENDATION	IMPLEMENTED YES	IMPLEMENTED NO
Night Setback		✓
Replacement of inefficient Light Fixtures		✓
Ceiling Insulation		✓
Wall Insulation		✓
Wall Insulation (CMU wall)		✓
Caulking and Weatherstripping		✓
Storm Windows		✓
Replace Inefficient Site Lighting		✓
Overhead Door Replacement		✓
Timer Switches (water pumps, etc.		✓
Water Heater Controls		✓
Solar Domestic Water Heater		✓
Trombe Wall Adaptation		✓
Conversion To Wood Stoker Boiler		✓
Photocell and Time Clock Controls for Lighting		✓
Replacement of Stand. Fluor. with High Eff. Light		✓
Selective Switching of Lights		✓
High Efficiency Motors		✓
Domestic Hot Water Circulating Pump Controls		✓
Insulated Damper Panels		✓
Elimination of Domestic Hot Water in Admin Blgs.		✓
Reduction of Window Galzing		✓
Insulation of Hot Water Heaters		✓

Lighting Type:____________ Heating System Type:____________
Cooling System:____________
Approximate Age:________

New Additions:____________ Size:____________ Exposure:____

ADDITIONAL COMMENTS

(2) Small [illegible]
Dayton 1/4 hp, 1725 RPM
115/220, 60Hz, 3Ø

(6) AIRTHERM ceiling unit heaters
Model RR55
Serial —

Hot water tank - 6' x 11'
1" FIBERGLASS INSULATION
Hot water pumps continuous - 2 - 1.25 hp

Cleaver BROOKS PACKAGE Boiler
model - CB11 36-80 ~~30~~ 20 ~~[illegible]~~.
Serial - L 47424 Pressure: 30 HW
INPUT - 2511000 Btu/hr DATE 5/15/69

18 GPH #2 oil
Boiler temp 140 ≈ 180

BUILDING 1240

RECOMENDATION	IMPLEMENTED YES	IMPLEMENTED NO
Night Setback		✓
Replacement of inefficient Light Fixtures		✓
Ceiling Insulation		✓
Wall Insulation		✓
Wall Insulation (CMU wall)		✓
Caulking and Weatherstripping		✓
Storm Windows		✓
Replace Inefficient Site Lighting		✓
Overhead Door Replacement		✓
Timer Switches (water pumps, etc.) / Power Co.)	✓	
Water Heater Controls	✓	
Solar Domestic Water Heater		✓
Trombe Wall Adaptation		✓
Conversion To Wood Stoker Boiler		✓
Photocell and Time Clock Controls for Lighting		✓
Replacement of Stand. Fluor. with High Eff. Light		✓
Selective Switching of Lights		✓
High Efficiency Motors		✓
Domestic Hot Water Circulating Pump Controls		✓
Insulated Damper Panels		✓
Elimination of Domestic Hot Water in Admin Blgs.		✓
Reduction of Window Galzing	✓	
Insulation of Hot Water Heaters		✓

Lighting Type: Flum.

Heating System Type: oil
Cooling System: WINDOW - 2 UNITS
Approximate Age: ________

New Additions: ________

Size: 4 425

Exposure: ____

ADDITIONAL COMMENTS

Remove heaters (3) - shut off - disconnected (Ceiling hung)

OLD SCHOOL HOUSE

ADMIN.

BUILDING 214

RECOMENDATION	IMPLEMENTED YES	IMPLEMENTED NO
Night Setback		✓
Replacement of inefficient Light Fixtures		
? Ceiling Insulation		
? Wall Insulation		
Wall Insulation (~~CMU wall~~)		
Caulking and Weatherstripping		
2x4 GLG. Storm Windows	✓	
Replace Inefficient Site Lighting		
Overhead Door Replacement	—	—
Timer Switches (water pumps, etc.		
Water Heater Controls		✓
Solar Domestic Water Heater		✓
Trombe Wall Adaptation		
Conversion To Wood Stoker Boiler		
Photocell and Time Clock Controls for Lighting	✓	
Replacement of Stand. Fluor. with High Eff. Light		
Selective Switching of Lights		
High Efficiency Motors		
Domestic Hot Water Circulating Pump Controls		✓
Insulated Damper Panels		
Elimination of Domestic Hot Water in Admin Blgs.		✓
Reduction of Window Galzing		
Insulation of Hot Water Heaters		✓

Lighting Type:______________

Heating System Type:______________
Cooling System:______________
Approximate Age:__________

New Additions:______________ Size:______________ Exposure:_____

ADDITIONAL COMMENTS

WINDOW SHADES

CARRIER MOD. 51CM/GM

NEW PANEL

200 200

40 40

14 USED -3

GAS WATER HT.
40 GAL
36,000 IN
4.5 SHOWR
4/1

PROJECT NO. 92008 DATE: NOV. 5, 1992

PROJECT: ESOS AT FORT A. P. HILL AND FORT BELVOIR

FIELD SURVEY FORM

BUILDING # 1529 & 1528 FORT A. P. HILL

SPACE ID - SPACE USAGE BARRACKS (5 men)

ENVELOPE CHARACTERISTICS (TYPE AND CONSTRUCTION):

WALLS 8" CMU

ROOF/CEILING (TOP FLOOR ONLY) DRYWALL CLG. @ 8' [illegible] ROOF

WINDOWS SINGLE PANE

STORM WINDOWS NO

INTERNAL LOADS:

NUMBER OF PEOPLE 100 (50 EA SIDE)

LIGHTING: TYPE FLUOR. 1x4 SURF 2LAMP NO. OF FIXTURES ~~56~~ 62 WATTAGE 80

TYPE INC. FOUND IN LATRINE NO. OF FIXTURES 6 WATTAGE

EQUIPMENT:

COMPUTERS: NO. WATTS (OR HEAT OUTPUT)

APPLIANCES: TYPE 2 WASHER NO. WATTS

TYPICAL SIZE COIN OP TYPE 2 DRYERS NO. WATTS

HOURS OF OPERATIONS:

WEEKDAYS

SATURDAYS

SUNDAYS

HOLIDAYS

HVAC EQUIPMENT (SERVING THE SPACE): (SEE NEXT PAGE)

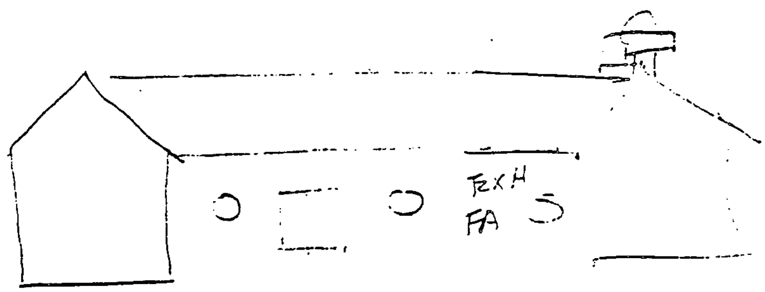
NAMEPLATE DATA ______________________________

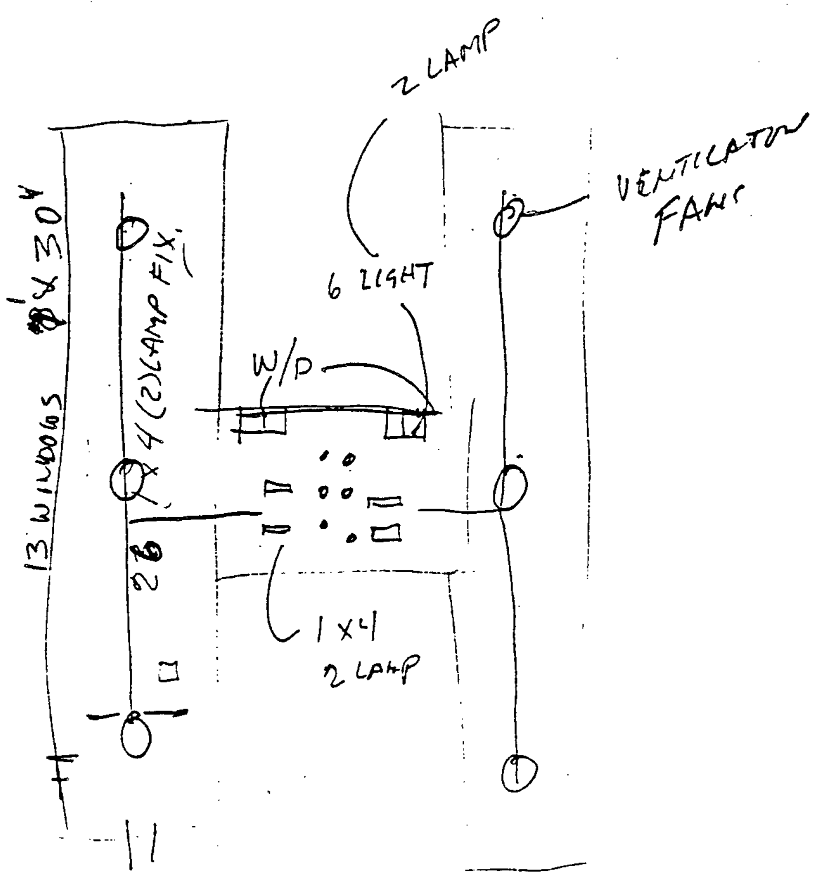
____

____

NUMBER OF UNITS ______________________________

MISCELLANEOUS





HVAC EQUIPMENT (SERVING THE SPACE):

NAMEPLATE DATA Armstrong 402496 MOD: L 11350-1

SN: 26053C5 AF9, 9 GPH, OUTPUT - 350,000 Btu/HR

9A, 230V

NUMBER OF UNITS

MISCELLANEOUS

Hot water Boiler V-1-96T WATER @ 30psi

SN: 22040453

HTG - 96MBH | WATER 83.5 MBH | .8GPH

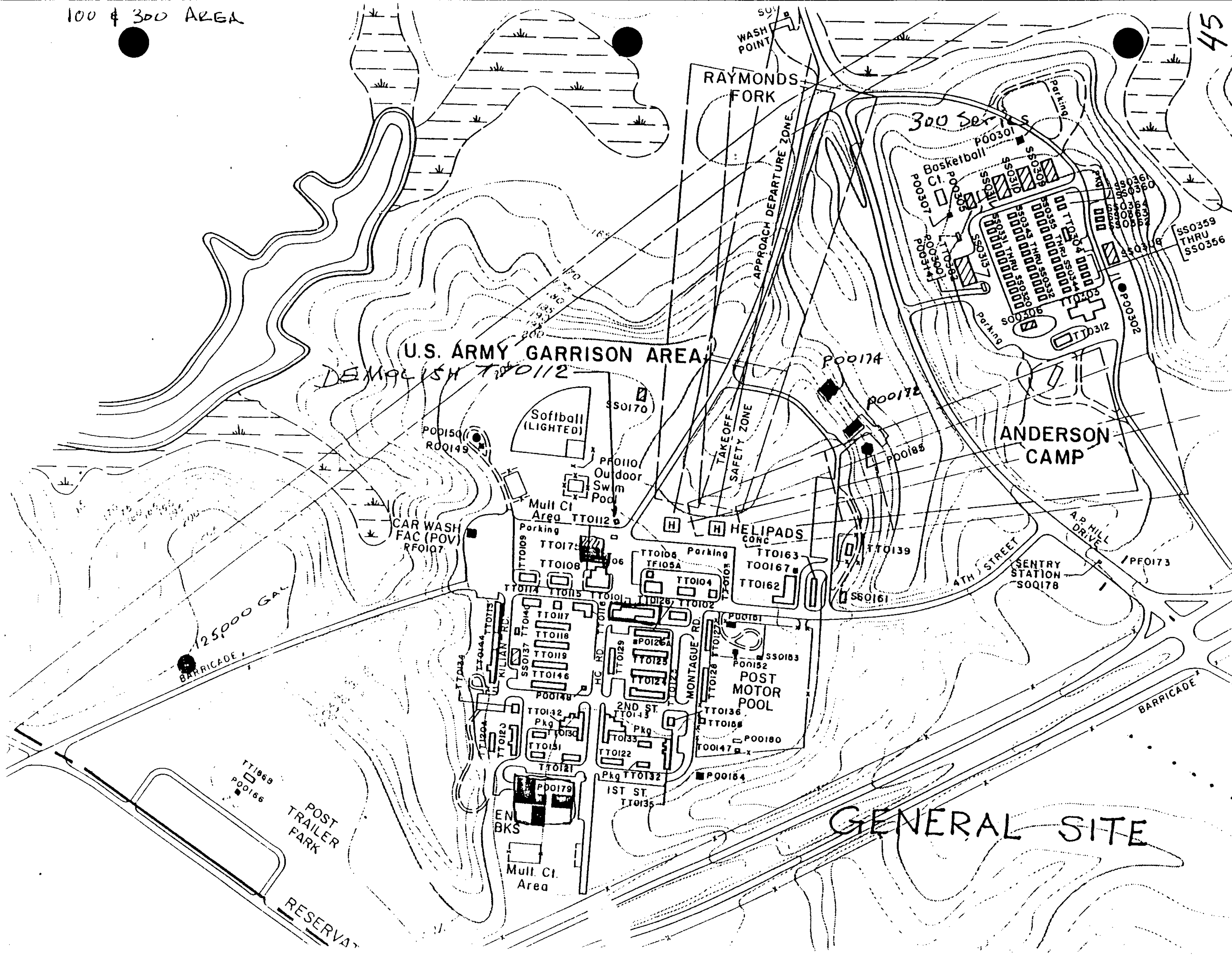
GP | #2oil

Hot water Tank 3x7, 370 gal.

170°F 1" FIBERGLASS INSULATION

100 & 300 AREA

45



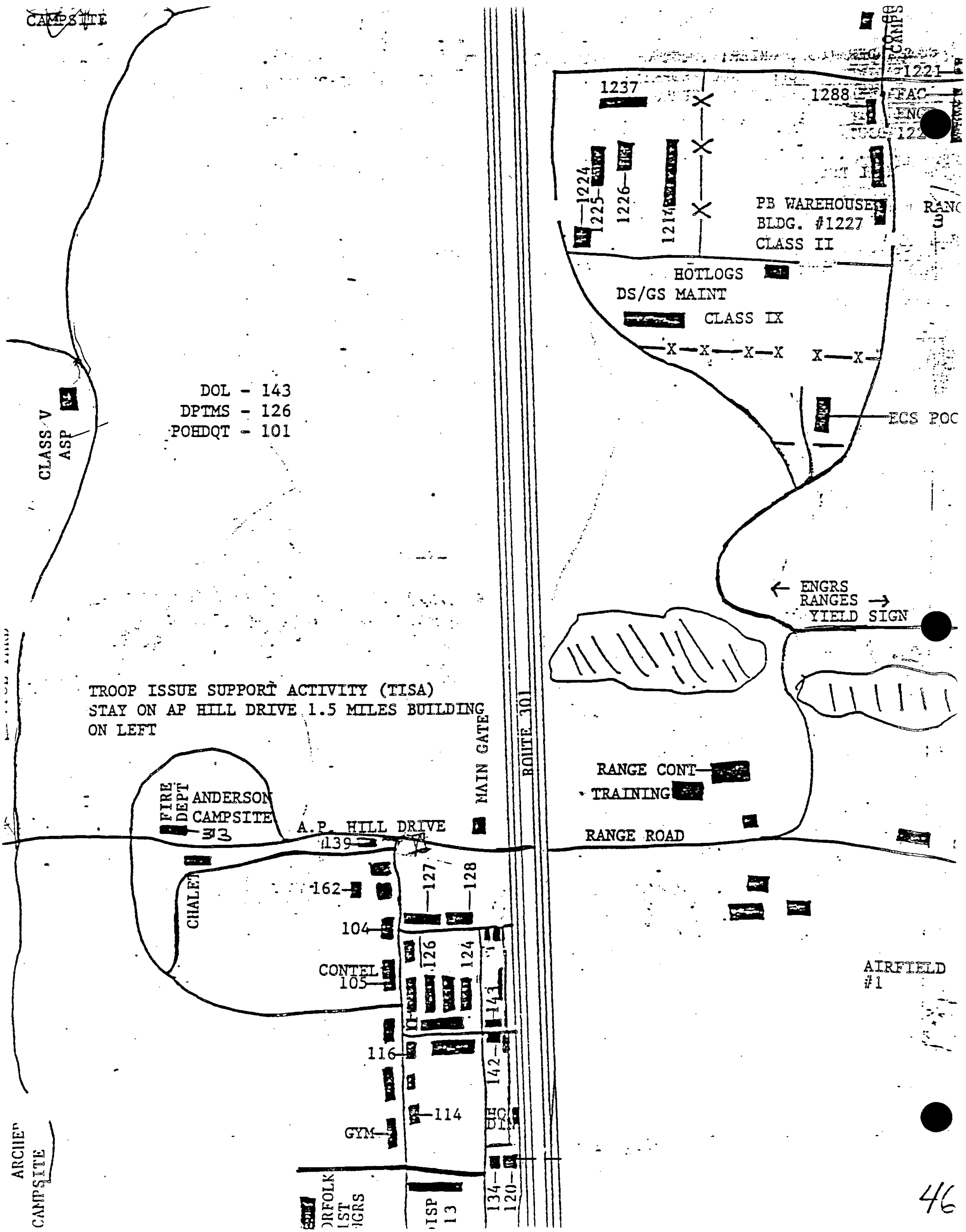

CAMPSITE
1237
1288
1221
FAC
ENGR
1224
1225
1226
1214
PB WAREHOUSE
BLDG. #1227
CLASS II
HOTLOGS
DS/GS MAINT
CLASS IX
ECS POC
CLASS V
ASP
DOL - 143
DPTMS - 126
POHDQT - 101
ENGRS
RANGES
YIELD SIGN
TROOP ISSUE SUPPORT ACTIVITY (TISA)
STAY ON AP HILL DRIVE 1.5 MILES BUILDING
ON LEFT
MAIN GATE
ROUTE 301
RANGE CONT
TRAINING
FIRE DEPT
ANDERSON
CAMPSITE
A.P. HILL DRIVE
RANGE ROAD
139
162
127
128
CHALET
104
126
124
CONTEL
105
141
116
142
114
GYM
AIRFIELD
#1
ARCHER
CAMPSITE
134
120

Table of Contents- Appendix D

BUILDING ON BASE BY USE GROUP

BUILDING USE-GROUP	SUB-GROUP NO.	STUDY BUILDING NO.	WALL CODE	ROOF CODE	EN. SYS. CODE	TOTAL SUB-GROUP SQUARE FEET	TOTAL USE-GROUP SQUARE FEET
Administration	A-1	101/126/214	WD	PS	AB	138,136	
	A-2	none	VARIES	VARIES	B	76,830	214,966
Quarters	B-1	179/311	WD	PS	AB	127,281	
	B-2	1528	MAS	PS	AB	38,967	
	B-3	none	Varies	Varies	B	310,726	476,974
Shops	C-1	313	WD	PS	AB	38,394	
	C-2	1290	MAS	BU	AB	87,503	
	C-3	none	varies	varies	B	34,690	185,380
Latrines	E-1	821	MAS	BU	AB	19,573	
	E-2	none	varies	varies	B	13,961	33,534
Nonenergized	F-1	none	varies	varies	O	149,038	149,038
TOTAL BUILDING AREA							1,149,027

Wall Construction Code:
- WD - Wood or metal frame with wook siding, metal siding or brick veneer.
- MAS - Masonry block or brick.

Roof Construction Code:
- PS - Pitched shingle over wood deck or metal roofing.
- BU - Built-up roof over wood or metal deck.

Energized systems Code:
- AB - Heating and non-heating systems.
- B - Non-heating systems only.
- O - No energized systems.

FORT A.P. HILL BUILDING USE-GROUP SUMMARY
FIGURE 1

FORT A.P. HILL
BUILDING CLASSIFICATION BY USE-GROUP

BUILDING NUMBER	AREA	USER GROUP
101	05080	A-1
103	00430	
104	01464	
105	02273	
109	01525	
113	02400	
115	00480	
116	02050	
120	21600	
121	01455	
122	01455	
123	02400	
124	02490	
126	02490	
127	02490	
128	02668	
129	01600	
134	00962	
135	02144	
136	00900	
137	01740	
139	00800	
140	00310	
144	02720	
145	01918	
158	00361	
163	01920	
201	03106	
214	11191	
217	02088	
224	03555	
250	02720	
251	05022	
304	01213	
312	01537	
742	03066	
815	01023	
816	01023	
817	01023	
818	01023	
1201	00700	
1206	01024	
1220	03819	
1221	00505	
1225	01024	
1227	00528	
1231	02079	
1247	01800	

BUILDING NUMBER	AREA	USER GROUP
1252	05000	A-1
1253	05000	
1262	03240	
1527	01728	
1535	01934	
2001	00800	
9071	03240	A-1

NUMBER OF BUILDINGS = 55 TOTAL AREA = 138,136

178	00060	A-2
226	01008	A-2
512	00960	
714	01920	
807	00960	
1304	00960	
1404	00960	
1504	00960	
1604	00960	
1630	02535	
1632	02535	
1633	01330	
1634	02535	
1650	03663	
1654	01330	
1656	03361	
1664	03661	
1672	02535	
1673	01330	
1677	02535	
1679	02535	
1683	02535	
1684	01330	
1685	02535	
1687	02535	

NUMBER OF BUILDINGS = 26 TOTAL AREA = 76,830

117	02400	B-1
118	02400	B-1
119	02400	
125	02541	
130	00861	
131	00861	
132	00800	
133	00800	
146	02200	
174	04800	
179A	05681	
205	01906	
207	00444	

BUILDING NUMBER	AREA	USER GROUP
208	05220	B-1
209	00532	B-1
211	00995	
215	02400	
254	01526	
290	01056	
292	01056	
293	01175	
294	01175	
308	03247	
309	03247	
310	03247	
311	03247	
320	00528	
321	00528	
322	00528	
323	00528	
324	00528	
325	00528	
326	00528	
327	00528	
328	00528	
329	00528	
330	00528	
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347	00528	
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349	00528	
350	00528	
351	00528	
352	00528	
353	00528	
354	00528	
355	00528	
356	00528	
357	00528	

BUILDING NUMBER	AREA	USER GROUP
358	00528	B-1
359	00528	B-1
360	00528	B-1
361	00528	
362	00528	
363	00528	
712	00960	
713	00960	
715	00960	
801	02740	
364	00528	
1205	00788	
1350	06202	
1351	06202	
1352	06202	
1353	03966	
1354	02240	
1355	03156	
1356	06726	
1357	06202	

NUMBER OF BUILDINGS = 84 TOTAL AREA = 127,281

253	01152	B-2
1526	07563	B-2
1528	07563	B-2
1529	07563	
1532	07563	
1533	07563	B-2

NUMBER OF BUILDINGS = 6 TOTAL AREA = 38,967

1635	03441	B-3
1636	03441	B-3
1637	09633	
1638	09633	
1639	09633	
1640	09633	
1642	09633	
1643	09633	
1644	09633	
1645	09633	
1646	09633	
1647	09633	
1648	09633	
1649	03441	
1651	03441	
1652	09633	
1653	09633	
1655	03441	
1657	09633	

BUILDING NUMBER	AREA	USER GROUP
1658	09633	B-3
1662	09633	B-3
1663	09633	
1666	09633	
1667	09633	
1668	09633	
1669	09633	
1671	03441	
1680	03441	
1681	03441	
1682	03441	
1688	09683	
1689	09683	
1691	09683	
1692	09683	
1693	09683	
1695	09683	
1696	09683	B-3
1694	09683	B-3
NUMBER OF BUILDING = 38	TOTAL AREA = 310,726	
102	01604	C-1
106A	04636	C-1
142	03384	
313	05171	
708	00260	
808	04036	
1214	08712	
1224	01024	
1226	02000	
1248	07500	C-1
1282	00067	C-1
NUMBER OF BUILDING = 11	TOTAL AREA = 38,394	
148	00100	C-2
149	00128	C-2
151	01098	
219	00136	
220	00064	
258	00064	
374	00100	
501	00087	
705	00087	
803	00087	
1203	03600	
1213	00069	
1219	00960	
1222	00087	C-2
1237	15000	C-2

BUILDING NUMBER	AREA	USER GROUP
1290	09306	C-2
1301	00087	C-2
1326	02400	
1327	02400	
1335	00080	
1336	37800	
1340	07200	
1401	00087	
1501	00087	
1545	02400	
1546	02400	
1601	00087	C-2
1611	01502	C-2

NUMBER OF BUILDINGS = 28 TOTAL AREA = 87,503

106B	00800	C-3
108	01525	C-3
182	01824	
206	00792	
222	01856	
257	02584	
575	04000	
711	00400	
730	00960	
985	00032	
986	00392	
989	00392	
1207	00392	
1208	02995	
1210	00740	
1211	00946	
1213B	00256	
1215	04000	
1216	04000	
1217	04000	
1221	00960	
1230	00120	
1268B	00280	
1293	00193	
1296	04000	
1323	00960	
1324	00960	
1423	00960	
1425	00960	
1429	00196	
1474	00064	
1523	00960	
1524	00960	
1538	00960	C-3
1623	00960	C-3

BUILDING NUMBER	AREA		USER GROUP
1624	00960		C-3
2002	03200		C-3
NUMBER OF BUILDINGS = 38		TOTAL AREA = 59,483	
143	03788		D-1
172	04272		D-1
179B	06275		
216	03500		
303	05268		
811	03189		
812	03189		
813	03189		D-1
814	03599		D-1
NUMBER OF BUILDINGS = 9		TOTAL AREA = 32,193	
820	06176		D-2
1525	12000		D-2
NUMBER OF BUILDINGS = 2		TOTAL AREA = 18,176	
175	00200		D-3
1204	01280		D-3
1641	11070		
1659	11070		D-3
1690	11070		D-3
NUMBER OF BUILDINGS = 5		TOTAL AREA = 34,690	
227	00819		E-1
305	01250		E-1
306	01250		
506	00720		
530	01000		
707	01494		
708	01656		
804	01920		
821	05984		
1320	00240		
1320	01000		
1521	00240		
1522	01000		E-1
1622	01000		E-1
NUMBER OF BUILINGS = 14		TOTAL AREA = 19,573	
63	00108		E-2
67	00108		E-2
246	00045		E-2
252	00576		E-2

BUILDING NUMBER	AREA	USER GROUP
265	00108	E-2
412	00143	E-2
413	00142	
527	00045	
529	00090	
531	00143	
723	00108	
724	00108	
725	00108	
726	00108	
728	00108	
733	00090	
745	00144	
746	00144	
748	00143	
806	00800	
826	00144	
828	00144	
830	00032	
831	00041	
839	00143	
847	00108	
916	00108	
924	00108	
928	00143	
980	00108	
1001	00108	
1003	00108	
1006	00108	
1008	00143	
1024	00144	
1108	00143	
1109	00144	
1110	00144	
1114	00144	
1116	00144	
1202	00143	
1219	00108	
1241	00533	
1242	00533	
1254	00143	
1256	00108	
1257	00108	
1260	00108	
1261	00108	
1263	00143	
1306	00108	
1307	00108	
1308	00108	
1309	00108	E-2
1310	00108	E-2

//

BUILDING NUMBER	AREA	USER GROUP
1311	00108	E-2
1312	00108	E-2
1313	00108	
1314	00108	
1315	00108	
1316	00108	
1317	00108	
1318	00108	
1330	00108	
1331	00108	
1332	00108	
1403	00090	
1405	00090	
1406	00108	
1407	00108	
1408	00108	
1408	00108	
1410	00108	
1411	00108	
1412	00108	
1413	00108	
1414	00108	
1415	00108	
1416	00108	
1417	00108	
1418	00045	
1419	00045	
1420	00045	
1428	00144	
1506	00108	
1507	00108	
1508	00108	
1509	00108	
1510	00108	
1511	00010	
1512	00108	
1513	00108	
1514	00108	
1515	00108	
1516	00108	
1517	00108	
1518	00108	
1520	00045	
1541	00108	
1543	00108	
1548	00108	
1619	00090	
1661	00108	
1670	00144	E-2
S1272	00108	E-2

NUMBER OF BUILDINGS = 107   TOTAL AREA = 13,961

BUILDING NUMBER	AREA	USER GROUP
50	00064	F-1
51	00064	F-1
105A	00086	
111	00384	
114	01440	
126	00176	
152	00048	
153	00152	
161	00108	
162	04800	
164	00528	
166B	00512	
170	00800	
171	00064	
176	00108	
181	07633	
183	00108	
185	01100	
187	00294	
188	00240	
189	00240	
221	00960	
228	04000	
229	04000	
231	00108	
232	00108	
233	00108	
234	00108	
235	00108	
236	00196	
240	00108	
241	00045	
242	00108	
247	00108	
249	00108	
253	01152	
255	00168	
256	00392	
259	00045	
263	00720	
264	00245	
266	00108	
269	00081	
286	01200	
381	00210	
384	00072	
398	00108	
399	00512	F-1
404	00108	F-1

BUILDING NUMBER	AREA	USER GROUP
405	00108	F-1
406	00108	F-1
407	00108	
408	00108	
409	00108	
415	00196	
516	00108	
517	00108	
518	00108	
519	00108	
520	00108	
521	00108	
522	00108	
523	00108	
524	00108	
525	00108	
526	00108	
710	05000	
718	00108	
719	00108	
721	00108	
722	00108	
731	00960	
736	00408	
737	01100	
738	00540	
743	00114	
744	00113	
840A	00108	
840B	00800	
844A	00108	
844B1	00800	
845A	00108	
846A	00108	
848A	00108	
848B2	00800	
849	01100	
850A	00108	
852A	00108	
852B	00800	
854A	00108	
856	01200	
900	00600	
903	00108	
904	00108	
907	00108	
908	00108	
909	00108	
909B2	00160	
910	00160	F-1
911	00108	F-1

BUILDING NUMBER	AREA	USER GROUP
912	00108	F-1
915	00160	F-1
919	00160	
924	00108	
925	00392	
937	02460	
977	00160	
978	00160	
979	00160	
981	00160	
987	00392	
990	00160	
1002	00108	
1004	00108	
1007	00108	
1013	00108	
1015	00108	
1016	00108	
1022	00108	
1023	00108	
1025	00108	
1101	00108	
1105	00108	
1106	00192	
1107	00192	
1203	00204	
1209	07633	
1212	00130	
1214	00143	
1218	04000	
1228	00448	
1232	04000	
1233	01995	
1234	00800	
1235	01920	
1236	00160	
1238	00800	
1239	00960	
1240	00756	
1244	01680	
1256	00108	
1265	00108	
1266	00108	
1273B	00192	
1274	00800	
1275	00800	
1276	00800	
1277	00800	
1278	00800	
1279	01920	F-1
1281	01920	F-1

BUILDING NUMBER	AREA	USER GROUP
1284	05000	F-1
1288	07500	F-1
1292	00960	
1294	03000	
1295	00192	
1297	00800	
1298	02880	
1299	10000	
1305	01840	
1333	01100	
1337	00120	
1432	00243	
1505	04000	
1559	00196	
1561	00280	
1562	00196	
1605	00024	
1610	00240	
1612	00240	
1621	01110	
1631	02369	
1660	00400	
1675	01110	
1676	01110	
1678	02369	
1686	02369	
1697	00400	
2003	00403	
2004	00403	
2005	01500	
2006	01500	
2007	01500	
2008	01500	
2009	01500	
2010	01500	
2011	01500	
2012	01500	
2013	01500	
2016	00096	
2018	01920	
FO107	00760	
SO802	00160	
SO991	01500	
TO190	00880	
TO927	00450	F-1
T1245	01680	F-1

NUMBER OF BUILDINGS = 200 TOTAL AREA = 149,038

TOTAL NUMBER OF BUILDINGS = 623 GRAND TOTAL AREA = 1,144,951

CLIMATOLOGICAL DATA

NORMALS, MEANS, AND EXTREMES

RICHMOND, VIRGINIA

LATITUDE: 37°30'N LONGITUDE: 77°20' W ELEVATION: FT. GRND 164 BARO 178 TIME ZONE: EASTERN WBAN: 13[illegible]

	(a)	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEP	OCT	NOV	DEC	YEAR
TEMPERATURE °F:														
Normals														
-Daily Maximum		46.7	49.6	58.5	70.6	77.9	84.8	88.4	87.1	81.0	70.5	60.5	50.2	68.8
-Daily Minimum		26.5	28.1	35.8	45.1	54.2	62.2	67.2	66.4	59.3	46.7	37.3	29.6	46.5
-Monthly		36.6	38.9	47.2	57.9	66.1	73.5	77.8	76.8	70.2	58.6	48.9	39.9	57.7
Extremes														
-Record Highest	62	80	83	93	96	100	104	105	102	103	99	86	80	105
-Year		1950	1932	1938	1990	1941	1952	1977	1983	1954	1941	1974	1971	JUL 1977
-Record Lowest	62	-12	-10	11	23	31	40	51	46	35	21	10	-1	-12
-Year		1940	1936	1960	1985	1956	1967	1965	1934	1974	1962	1933	1942	JAN 1940
NORMAL DEGREE DAYS:														
Heating (base 65°F)		880	731	552	226	65	0	0	0	24	221	483	778	3960
Cooling (base 65°F)		0	0	0	13	99	258	397	366	180	23	0	0	1336
% OF POSSIBLE SUNSHINE	41	54	58	62	65	66	70	68	66	64	63	59	54	62
MEAN SKY COVER (tenths)														
Sunrise - Sunset	46	6.4	6.3	6.2	6.1	6.3	6.0	6.2	6.1	5.8	5.4	5.8	6.1	6.0
MEAN NUMBER OF DAYS:														
Sunrise to Sunset														
-Clear	46	8.3	8.2	8.2	7.9	7.0	6.8	6.8	7.2	9.3	11.6	9.5	9.7	100.5
-Partly Cloudy	46	6.7	6.3	8.3	9.1	10.0	12.0	11.7	11.7	8.7	7.3	7.7	6.3	105.8
-Cloudy	46	15.9	13.7	14.5	13.0	13.9	11.2	12.5	12.1	12.1	12.1	12.8	15.0	158.9
Precipitation .01 inches or more	54	10.3	9.3	10.8	9.3	10.7	9.5	11.1	9.8	7.9	7.2	8.2	8.9	112.9
Snow, Ice pellets, hail 1.0 inches or more	54	1.3	1.1	0.6	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.6	3.9
Thunderstorms	54	0.2	0.4	1.6	2.5	5.5	6.8	8.7	6.6	2.9	1.0	0.6	0.3	36.9
Heavy Fog Visibility 1/4 mile or less	62	2.7	2.1	1.7	1.7	1.9	1.5	2.1	2.5	3.0	3.3	2.3	2.8	27.5
Temperature °F														
-Maximum														
90° and above	62	0.0	0.0	0.1	0.8	2.8	9.5	13.9	11.0	4.5	0.4	0.0	0.0	42.9
32° and below	62	3.2	1.5	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.*	1.7	6.6
-Minimum														
32° and below	62	21.4	18.8	10.3	2.1	0.1	0.0	0.0	0.0	0.0	1.8	10.0	20.1	84[illegible]
0° and below	62	0.4	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.*	0[illegible]
AVG. STATION PRESS. (mb)	19	1012.8	1012.6	1010.9	1009.3	1009.3	1009.5	1010.1	1011.2	1012.3	1013.4	1013.2	1013.7	1011.5
RELATIVE HUMIDITY (%)														
Hour 01	57	77	74	73	74	83	86	88	90	90	87	80	77	82
Hour 07 (Local Time)	57	80	79	78	76	80	82	85	89	90	89	84	81	83
Hour 13	57	57	53	49	46	51	53	56	57	56	53	51	55	53
Hour 19	57	68	63	58	55	64	67	71	75	78	76	69	69	68
PRECIPITATION (inches):														
Water Equivalent														
-Normal		3.23	3.13	3.57	2.90	3.55	3.60	5.14	5.01	3.52	3.74	3.29	3.39	44.07
-Maximum Monthly	54	7.97	5.97	8.65	7.31	8.87	9.24	18.87	14.10	10.98	9.39	7.64	7.07	18.87
-Year		1978	1979	1984	1987	1972	1938	1945	1955	1975	1971	1959	1973	JUL 1945
-Minimum Monthly	54	0.64	0.48	0.94	0.64	0.87	0.38	0.51	0.52	0.26	0.30	0.36	0.40	0.26
-Year		1981	1978	1966	1963	1965	1980	1983	1943	1978	1963	1965	1980	SEP 1978
-Maximum in 24 hrs	54	3.31	2.67	2.88	2.97	3.08	4.61	5.73	8.79	4.02	6.50	4.07	3.16	8.79
-Year		1962	1979	1991	1987	1981	1963	1969	1955	1985	1961	1956	1958	AUG 1955
Snow, Ice pellets, hail														
-Maximum Monthly	54	28.5	21.4	19.7	2.0	T	0.0	0.0	0.0	0.0	T	7.3	12.5	28.5
-Year		1940	1983	1960	1940	1989					1979	1953	1958	JAN 1940
-Maximum in 24 hrs	54	21.6	16.8	12.1	2.0	T	0.0	0.0	0.0	0.0	T	7.3	7.5	21.6
-Year		1940	1983	1962	1940	1989					1979	1953	1966	JAN 1940
WIND:														
Mean Speed (mph)	43	8.1	8.6	9.1	8.9	7.8	7.4	6.8	6.4	6.7	7.0	7.6	7.8	7.7
Prevailing Direction through 1963		S	NNE	W	S	SSW	S	SSW	S	S	NNE	S	SW	S
Fastest Obs. 1 Min.														
-Direction (!!!)	6	26	32	27	21	23	30	35	18	36	36	27	21	23
-Speed (MPH)	6	28	32	41	29	46	32	39	30	37	29	32	32	46
-Year		1990	1987	1989	1990	1989	1987	1986	1991	1989	1990	1989	1988	MAY 1989
Peak Gust														
-Direction (!!!)	7	NW	NW	W	W	SW	NW	N	NW	N	N	SW	SW	SW
-Speed (mph)	7	48	48	67	48	79	53	61	44	49	43	54	49	79
-Date		1985	1987	1989	1988	1989	1987	1986	1986	1989	1990	1988	1988	MAY 1989

(!!!) See Reference Notes on Page 68.

HEATING DEGREE DAYS Base 65 deg. F — RICHMOND, VIRGINIA

SEASON	JULY	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUNE	TOTAL
1962-63	0	0	73	175	526	891	897	882	434	218	102	1	4199
1963-64	0	0	71	197	439	1004	826	801	537	306	74	12	4267
1964-65	0	0	32	352	402	676	909	726	674	339	17	34	4161
1965-66	0	6	25	275	498	726	1043	759	538	371	133	27	4401
1966-67	0	0	47	293	466	833	738	841	560	230	171	17	4196
1967-68	0	0	64	256	623	708	956	887	416	191	86	0	4187
1968-69	0	0	0	161	403	864	957	783	695	237	66	0	4166
1969-70	0	0	45	221	541	907	1076	778	677	231	51	0	4527
1970-71	0	0	12	124	445	756	960	709	627	295	104	3	4035
1971-72	0	0	11	69	512	526	748	788	554	286	58	21	3573
1972-73	0	0	17	285	513	588	843	735	394	247	79	0	3701
1973-74	0	0	5	163	414	744	589	691	455	204	75	5	3345
1974-75	0	0	62	310	513	715	746	654	604	368	44	1	4017
1975-76	0	0	27	121	356	770	917	480	386	227	78	11	3373
1976-77	0	1	15	332	660	869	1227	680	366	176	42	7	4375
1977-78	0	0	4	259	401	784	974	964	627	235	88	5	4341
1978-79	0	0	16	214	366	694	876	1011	439	218	44	4	3882
1979-80	0	0	8	242	353	698	806	835	541	135	47	2	3667
1980-81	0	0	14	267	557	813	1042	633	626	171	107	0	4230
1981-82	0	1	29	273	473	834	1029	645	486	280	6	1	4057
1982-83	0	6	10	213	399	585	836	718	445	282	69	2	3565
1983-84	0	1	86	236	475	887	994	589	657	282	93	3	4303
1984-85	0	0	73	57	546	531	997	692	484	177	35	5	3597
1985-86	0	0	31	114	257	838	886	713	465	187	78	3	3572
1986-87	0	16	24	172	476	741	931	777	550	317	57	0	4061
1987-88	0	0	5	370	409	677	1008	746	527	279	79	32	4132
1988-89	0	0	27	361	425	794	696	709	546	293	108	0	3959
1989-90	0	3	38	181	468	1036	574	472	436	258	50	3	3519
1990-91	0	0	33	146	365	574	762	582	443	193	27	1	3126
1991-92	0	0	25	190	458	637							

See Reference Notes on Page 6B.

COOLING DEGREE DAYS Base 65 deg. F — RICHMOND, VIRGINIA

YEAR	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEP	OCT	NOV	DEC	TOTAL
1969	0	0	0	21	90	328	417	321	147	26	0	0	1350
1970	0	0	0	35	185	328	418	410	313	67	0	0	1756
1971	0	0	0	0	56	297	367	327	209	62	22	5	1345
1972	0	0	7	30	52	180	381	326	178	9	8	0	1171
1973	0	0	13	42	91	338	391	395	231	32	9	2	1544
1974	0	0	10	58	106	180	377	340	141	21	26	0	1259
1975	0	0	0	16	135	267	348	433	165	51	18	0	1433
1976	0	8	9	99	91	307	389	337	133	12	0	0	1385
1977	0	0	22	66	148	258	513	467	289	24	27	0	1814
1978	0	0	0	12	112	302	393	475	263	15	0	1	1573
1979	0	0	16	30	117	188	374	404	195	42	9	0	1375
1980	0	0	1	25	157	243	472	494	313	23	1	0	1729
1981	0	0	1	45	89	395	458	319	169	16	0	0	1492
1982	0	0	0	13	181	259	428	323	157	43	13	7	1424
1983	0	0	0	23	108	325	452	405	207	27	0	0	1547
1984	0	0	0	10	114	392	346	381	154	100	0	2	1499
1985	0	4	20	94	139	290	441	392	213	51	10	0	1654
1986	0	0	8	19	142	344	498	308	205	79	6	0	1609
1987	0	0	0	2	136	329	513	427	227	0	3	0	1637
1988	0	0	3	16	108	269	466	465	137	12	0	0	1476
1989	0	3	24	27	88	341	403	331	218	42	4	0	1481
1990	0	1	43	51	81	312	470	356	177	96	0	2	1589
1991	0	0	10	53	254	316	494	428	227	40	3	0	1825

See Reference Notes on Page 6B.

ENERGY CONSUMPTION TABULATIONS

Engineering
Applications
Consultants

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Burke, Virginia 22015-1630
(703) 978-0923

ENGINEERING ANALYSIS

Sheet ____ of ____

By: JS

ENERGY COSTS

Project: Fort A. P. Hill ESOS

Date: 2-28-94

Contract No.: DACA 31-89-C-0198

EAC Project No.: 92008

Source	Unit	Cost	Date
Fuel oil	GAL	.79	1994*
LP GAS	GAL	.74	1994*
ELECTRICITY	KWH	$.07	1994
	KW PEAK	8.00	

REF: Fuel oil, LP GAS - CONTRACT PRICES
ELECTRICITY - AVG 4 SUBSTATION

0

ENERGY CONSUMPTION

YEAR	FY75	FY76	FY77	FY78	FY79	FY80	FY89	FY90	FY91	FY92
ELECTRIC										
MWH	2,730	2,511	3,003	3,173	3,274	3,866	9,357	7,503	9,216	5,987
MBTU	31,666	29,127	34,830	36,803	37,978	44,842	31,936	25,608	31,453	20,433
LPGAS										
GAL	51,739	41,168	40,220	57,564	42,526	68,433	12,506	42,636	45,883	39,944
MBTU	4,941	3,932	3,841	5,497	4,061	6,535	1,194	4,072	4,382	3,815
FUEL OIL										
GAL	278,564	174,342	191,723	215,886	209,504	200,016	115,260	279,224	295,097	252,529
MBTU	38,637	24,181	26,592	29,943	29,058	27,742	15,987	38,728	40,930	35,026
KEROSENE										
GAL	(INCL/W	54,770	53,216	87,616	46,981	50,000	4,177	15,164	9,813	11,050
MBTU	FUEL OIL)	7,596	7,381	12,152	6,516	6,935	579	2,103	1,361	1,533
TOTAL MBTU	75,244	64,836	72,644	84,395	77,613	86,054	49,696	70,511	78,126	60,806

ELECTRICITY BILLING

FY 1989

MONTH	KWH	KW	$
JANUARY	844,680	1,852	$49,911.68
FEBRUARY	898,500	1,969	$53,402.19
MARCH	647,850	1,749	$40,797.32
APRIL	580,350	1,740	$35,016.60
MAY	661,930	2,014	$42,140.29
JUNE	954,030	1,812	$55,412.00
JULY	773,580	1,548	$47,705.50
AUGUST	700,180	1,362	$37,862.11
SEPTEMBER	607,450	1,676	$36,652.70
OCTOBER	658,280	1,447	$33,391.54
NOVEMBER	857,820	1,755	$47,433.94
DECEMBER	1,172,580	2,080	$62,623.13
TOTAL	9,357,230	21,005	$542,349.00

FY 1990

MONTH	KWH	KW	$
JANUARY	686,650	1,615	$40,664.91
FEBRUARY	767,950	1,819	$46,273.12
MARCH	722,130	1,812	$42,765.85
APRIL	541,630	1,344	$34,898.54
MAY	634,300	1,312	$34,348.71
JUNE	674,008	2,265	$45,758.56
JULY	686,352	1,934	$38,017.40
AUGUST	588,853	1,657	$33,779.04
SEPTEMBER	485,762	1,052	$30,849.08
OCTOBER	462,231	1,287	$25,740.42
NOVEMBER	531,204	1,490	$30,159.43
DECEMBER	722,058	1,654	$38,454.71
TOTAL	7,503,128	19,243	$441,709.77

FY 1991

MONTH	KWH	KW	$
JANUARY	1,060,525	2,226	$58,844.99 *
FEBRUARY	886,345	2,003	$51,078.63
MARCH	828,456	1,799	$46,540.27 *
APRIL	605,246	1,432	$36,686.22
MAY	723,400	1,742	$46,987.35 *
JUNE	821,463	1,833	$49,038.76
JULY	910,598	1,894	$52,683.94
AUGUST	782,497	1,880	$46,737.44
SEPTEMBER	505,909	1,494	$36,496.45
OCTOBER	589,131	1,359	$35,900.90
NOVEMBER	798,503	1,762	$47,835.40
DECEMBER	703,635	1,652	$46,985.52 *
TOTAL	9,215,708	21,075	$555,815.87

ELECTRICITY BILLING (Cont.)

FY 1992

MONTH	KWH	KW	$
JANUARY	690,061	1,387	$49,995.10 *
FEBRUARY	759,461	1,432	$49,013.14 *
MARCH	895,939	1,798	$51,879.51
APRIL	643,793	1,222	$41,475.17 *
MAY	693,091	1,482	$42,734.28
JUNE	675,511	1,434	$41,423.31 *
JULY	893,156	2,028	$54,324.03
AUGUST	735,761	1,589	$48,010.66 *
SEPTEMBER			
OCTOBER			
NOVEMBER			
DECEMBER			
TOTAL	5,986,773	12,372	$378,855.20

LP GAS

.TH	1989 GALLONS	COST ($)
JANUARY		
FEBRUARY		
MARCH		
APRIL		
MAY		
JUNE		
JULY		
AUGUST		
SEPTEMBER		
OCTOBER	6,652	$4,950.40
NOVEMBER	5,854	$2,897.60
DECEMBER		
TOTAL	12,506	$7,848.00

MONTH	1992 GALLONS	COST($)
JANUARY	8,126	$5,436.16
FEBRUARY	7,185	$4,734.59
MARCH	7,654	$5,043.98
APRIL	1,879	$1,256.85
MAY	1,929	$1,290.23
JUNE	6,472	$4,330.03
JULY	2,274	$1,521.57
AUGUST	2,875	$1,923.36
SEPTEMBER	1,551	$1,037.42
OCTOBER		
NOVEMBER		
DECEMBER		
TOTAL	39,944	$26,574.19

MONTH	1990 GALLONS	COST ($)
JANUARY	10,051	$4,975.26
FEBRUARY		
MARCH	10,177	$5,037.52
APRIL		
[illegible]	1,770	$876.20
...E	3,102	$1,628.35
JULY	4,545	$2,386.34
AUGUST	6,014	$2,976.98
SEPTEMBER		
OCTOBER		
NOVEMBER		
DECEMBER	6,977	$5,488.58
TOTAL	42,636	$23,369.23

MONTH	1991 GALLONS	COST ($)
JANUARY	4,962	$3,612.63
FEBRUARY	4,299	$2,574.87
MARCH	2,455	$1,470.24
APRIL	9,896	$6,551.92
MAY	1,860	$1,113.84
JUNE	3,454	$2,069.19
JULY	2,577	$1,543.51
AUGUST	2,818	$1,688.10
SEPTEMBER	4,744	$2,841.35
'BER	1,619	$969.90
MBER	1,880	$1,126.18
DECEMBER	5,320	$3,505.55
TOTAL	45,883	$29,067.28

#2 FUEL OIL

. ..NTH	1989 GALLONS	COST ($)
JANUARY		
FEBRUARY		
MARCH		
APRIL		
MAY		
JUNE		
JULY		
AUGUST		
SEPTEMBER		
OCTOBER	16,796	$9,405.76
NOVEMBER	38,605	$23,212.00
DECEMBER	59,859	$33,521.04
TOTAL	115,260	$66,138.80

MONTH	1990 GALLONS	COST ($)
JANUARY	65,545	$36,705.20
FEBRUARY	28,884	$16,174.16
MARCH	34,396	$19,261.76
APRIL	47,554	$26,630.24
	7,989	$4,473.84
..NE	14,463	$8,099.28
JULY	6,733	$3,770.48
AUGUST		
SEPTEMBER		
OCTOBER	4,403	$4,535.09
NOVEMBER	32,687	$33,667.61
DECEMBER	36,570	$37,667.10
TOTAL	279,224	$190,984.76

MONTH	1991 GALLONS	COST ($)
JANUARY	54,860	$56,505.80
FEBRUARY	47,584	$49,011.52
MARCH	39,934	$41,132.02
APRIL	40,475	$41,689.25
MAY	8,284	$8,532.52
JUNE	4,612	$4,750.36
JULY	4,540	$4,676.20
AUGUST	2,177	$2,242.31
SEPTEMBER		
'BER	6,211	$4,285.59
.MBER	37,857	$26,121.33
DECEMBER	48,563	$33,508.47
TOTAL	295,097	$272,455.37

KEROSENE

MONTH	1989 GALLONS	COST ($)
JANUARY		
FEBRUARY		
MARCH		
APRIL		
MAY		
JUNE		
JULY		
AUGUST		
SEPTEMBER		
OCTOBER	831	$465.36
NOVEMBER	2,148	$1,202.88
DECEMBER	1,198	$670.88
TOTAL	4,177	$2,339.12

MONTH	1990 GALLONS	COST ($)
JANUARY	2,824	$1,581.00
FEBRUARY	2,809	$1,573.04
MARCH	2,022	$1,132.32
APRIL	3,348	$1,874.88
MAY		
JUNE		
JULY		
AUGUST		
SEPTEMBER		
OCTOBER		
NOVEMBER	3,121	$3,214.63
DECEMBER	1,040	$1,071.20
TOTAL	15,164	$10,447.07

MONTH	1991 GALLONS	COST ($)
JANUARY	2,176	$2,241.28
FEBRUARY	2,008	$2,068.24
MARCH	1,219	$1,255.57
APRIL	1,003	$1,033.09
MAY		
JUNE		
JULY		
AUGUST		
SEPTEMBER		
OCTOBER	857	$591.33
NOVEMBER	2,099	$1,448.31
DECEMBER	451	$311.19
TOTAL	9,813	$8,949.01

#2 FUEL OIL

MONTH	1992 GALLONS	COST ($)
JANUARY	54,573	$37,655.37
FEBRUARY	53,828	$37,141.32
MARCH	55,074	$38,001.02
APRIL	40,756	$28,121.64
MAY	9,766	$6,738.54
JUNE	16,353	$11,283.57
JULY	5,776	$3,754.40
AUGUST	7,384	$5,094.96
SEPTEMBER	9,019	$6,223.11
OCTOBER		
NOVEMBER		
DECEMBER		
TOTAL	252,529	$174,013.93

KEROSENE

MONTH	1992 GALLONS	COST ($)
JANUARY	1,997	$1,377.93
FEBRUARY	3,045	$2,101.05
MARCH	1,966	$1,356.54
APRIL	3,042	$2,098.98
MAY	1,000	$690.00
JUNE		
JULY		
AUGUST		
SEPTEMBER		
OCTOBER		
NOVEMBER		
DECEMBER		
TOTAL	11,050	$7,624.50

LIFE CYCLE COST ANALYSIS SUMMARY
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)

LOCATION: Fort A.P. Hill, Virginia REGION: 3 PROJECT NO.: DACA 31-89-C-0198
PROJECT TITLE: Fort A.P. Hill- Energy Engineering Analysis Program FISCAL YEAR: 1994
DISCRETE PORTION NAME: Night Set-Back
ANALYSIS DATE: January 1994 ECONOMIC LIFE (YRS) 15 PREPARER: JJS

1. INVESTMENT COSTS:

A. CONSTRUCTION COST	$	37,631	
B. SIOH	$	2,070	
C. DESIGN COST	$	2,258	
D. TOTAL COST (1A+1B+1C)	$	41,959	
E. SALVAGE VALUE OF EXISTING EQUIPMENT			
F. PUBLIC UTILITY COMPANY REBATE			
G. TOTAL INVESTMENT (1D-1E-1F)			$41,959

2. ENERGY SAVINGS (+)/COST(-):

DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS- Oct 1992

ENERGY SOURCE	COST $/MBTU(1)	SAVING(S) MBTU/YR(2)		ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)		DISCOUNTED SAVINGS(5)
A. ELEC	$20.67	768.7	$	15,889	11.77	$	187,014
B. DIST	$5.69	5,544.5	$	31,548	13.83	$	436,312
C. RESID			$			$	
D. NG			$			$	
E. LPG	$7.76		$			$	
F. COAL			$			$	
G. SOLAR			$			$	
H. GEOTH			$			$	
I. BIOMA			$			$	
J. REFUS			$			$	
K. WIND			$			$	
L. OTHER			$			$	
M. DEMAND SAVINGS			$			$	
N. TOTAL		6,313	$	47,437		$	623,326

3. NON ENERGY SAVINGS (+) OR COST (-):

A. ANNUAL RECURRING (+/-)	($2,210)		
(1) DISCOUNT FACTOR (TABLE A)		10.56	
(2) DISCOUNTED SAVINGS/COST (3A X 3A1)			($23,338)

B. NON RECURRING SAVINGS (+) OR COST (-)

ITEM		SAVINGS(+) COST(-)(1)	YEAR OF OCCUR. (2)	DISCOUNT FACTOR(3)		DISCOUNTED SAV-INGS(+)COST(-)(4)
a.	$				$	
b.	$				$	
c.	$				$	
d. TOTAL					$	

C. TOTAL NON ENERGY DISCOUNTED SAVINGS (3A2+3Bd4) ($23,338)

4. SIMPLE PAYBACK 1G/(2N3+3A+(3Bd1/ECONOMIC LIFE)): 0.93 YEARS
5. TOTAL NET DISCOUNTED SAVINGS (2N5+3C): $599,988
6. SAVINGS TO INVESTMENT RATION (SIR) 5/1G: 14.30
7. ADJUSTED INTERNAL RATE OF RETURN (AIRR): 20.18%

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CONSTRUCTION COST ESTIMATE	Date Prepared: 1/27/94	Reference: MMM Design Group/ 1992 R.S. Means
Activity and Location: Energy Savings Opportunity Survey Fort A. P. Hill, Virginia	Constr. Contact No. DACA 31-89-C-0198	I.D. No.
	Estimated By: EAC, P.C.	Category Code
Project: Night Set-Back	Status: Final	Job Order No.

ITEM DESCRIPTION	QUANTITY		PRIME CONTRACTOR				SUBCONTRACTOR				TOTAL COST
			MATERIAL COST		LABOR COST		MATERIAL COST		LABOR COST		
	NUMBER	UNIT	UNIT COST	TOTAL	UNIT COST	TOTAL	UNIT COST	TOTAL	UNIT COST	TOTAL	
Installation of new solid state type thermostat w/wiring	85.00	EA	156.00	13,260	153.00	13,005					26,265
SUB - TOTAL				$13,260		$13,005					$26,265

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CONSTRUCTION COST ESTIMATE	Date Prepared: 1/27/94	
Activity and Location: Energy Savings Opportunity Survey Fort A. P. Hill, Virginia	Constr. Contact No. DACA 31-89-C-0198 Estimated By: EAC, P.C.	I.D. No. Category Code
Project: Night Set-Back	Status: Final	Job Order No.

ITEM DESCRIPTION	QUANTITY		PRIME CONTRACTOR				SUBCONTRACTOR				TOTAL COST
			MATERIAL COST		LABOR COST		MATERIAL COST		LABOR COST		
SUMMARY	NUMBER	UNIT	UNIT COST	TOTAL	UNIT COST	TOTAL	UNIT COST	TOTAL	UNIT COST	TOTAL	
Subtotal				13,260		13,005					
DIRECT COSTS				13,260		13,005					
SUBTOTAL (DIRECT COSTS)				13,260		13,005					
Material Tax & Labor Taxes			5.0%	663	21.0%	2,731	5.0%		21.0%		
Overhead			15.0%	1,989	15.0%	1,951	15.0%		15.0%		
SUBTOTAL				15,912		17,687					
Profit			12.0%	1,909	12.0%	2,122	12.0%		12.0%		
SUBTOTAL				17,821		19,809					
Prime Overhead on Sub							5.0%		5.0%		
SUBTOTAL											
Prime Profit on Sub							5.0%		5.0%		
TOTAL COST				17,821		19,809					37,631

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DESIGN ANALYSIS

☐ PRELIMINARY
☐ FINAL
☐ OTHER

PROJECT NAME: EEAP - A P HILL	PROJECT PART: NIGHT-SET-BACK	SPEC. DIVISION: THERMOSTATS
DEPARTMENT: MECHANICAL	COMPUTED BY: CTW DATE: 9/15/82	JOB NO: 4417.02
SHEET NO: OF:	CHECKED BY: DATE:	SHEET NO: OF:

GROUP	BLDG.	FT^2	NO. OF T'STATS
A	126	2490	1
B	1528	7563	1
C	313	5234	2
C	1290	9306	2
D	820	6176	1
D	179	6275	2
E	821	7056	2

SET-BACK THERMOSTAT REQUIREMENTS CANNOT BE ADEQUATELY ESTIMATED ON A PER-SQUARE-FOOT GROUP BASIS. IT IS ESTIMATED THAT EACH BUILDING WILL REQUIRE 1 T'STAT FOR EVERY 5000 FT^2 OF FLOOR AREA, OR PART THERE-OF. THIS CRITERIA PROVIDES AN ESTIMATE OF 89 T'STATS FOR 72 BUILDINGS.

MAINTENANCE

IT IS ESTIMATED THAT EACH T'STAT WILL REQUIRE 1 HR/YR FOR CALIBRATION. FOR EACH OF 14 YRS (INITIALLY CALIBRATED).

UNESCALATED COST: $\$17 \times 89 = \$1513$ (MEAN'S 1982)

ESCALATED COST: $\$1513 \times 1.07^2 \times 1.035 \times (7.729/7.960) = \$1791$

Engineering
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(703) 978-0923

ENGINEERING ANALYSIS

Sheet ______ of ______

By: ______

NIGHT SET BACK

Project: Fort A. P. Hill ESOS Date: 2-28-94

Contract No.: DACA 31-89-C-0198 EAC Project No.: 92008

BLg	Subgroup	AREA (FT²)
101	A-1	5030
105	A-1	2273
126	A-1	2634
127	A-1	2526
292	B-1	1056
293	B-1	1175
294	B-1	1175
1220	A-1	6464

AREA TO BE REMOVED PER GROUP

A-1 18,977

B-1 3,406

#TSTATS = 22383 FT²/5000

= 4

REDUCE # OF T STATS TO 85 INSTEAD OF 89

CALIBRATION ONCE PER YEAR FOR 14 (INITIALLY CALIBRATED [illegible] =

$26 x 85 = 2210

DESIGN ANALYSIS

☐ PRELIMINARY
☒ FINAL
☐ OTHER

PROJECT NAME: EEAP - AP HILL	PROJECT PART: NIGHT SET-BACK	SPEC. DIVISION:
DEPARTMENT: MECH	COMPUTED BY: CTW DATE: 9/9/82	JOB NO: 4417.02
SHEET NO: OF:	CHECKED BY: DATE:	SHEET NO: OF:

NIGHT SET-BACK

INVOLVED ADMINISTRATION & MESS HALL BLDGS:

		179	
		216	1262
113	135	224	1525
116	137	303	1527
121	144	304	1535
123	145	820	2001

10°F HEATING SET-BACK / COOLING SHUT-OFF : 1700 TO 0600

INVOLVED SHOPS

102	151	1214	1290
106 A	313	1224	1291
142	708	1226	

15°F HEATING SET-BACK / COOLING SHUT-OFF : 1700 TO 0600

INVOLVED BARRACKS & LATRINES

117	146	254	310	1528
118	179		311	1529
119	205		506	1532
125	207		707	1533
130	208	305	801	1622
131	209	306	821	
132	227	308	1205	
133	253	309	1526	

5°F HEATING SET-BACK : 2400 TO 0600

BUILDING GROUP ENERGY SAVINGS
NIGHT SETBACK

Sub Group	Synergy Adjustment Factor	Applied Group (SQ.-FT.)	Average Sub-Group Savings- BTU/FT^2-Yr			Total Sub-Group Savings MBTU/Yr		
			ELECTRIC	FUEL	TOTAL	ELECTRIC	FUEL	TOTAL
A-1	0.746	17,128	5,088	49,891	54,971	87.0	854.5	941.0
A-1W	0.803	9,344	3,737	11,093	14,829	28.0	83.2	111.0
B-1	0.673	43,560	1,190	27,357	28,547	51.8	1,191.0	1,242.8
B-1W	0.526	3,528	634	5,540	6,174	1.2	10.3	11.5
B-2	0.758	38,967	1,190	27,357	28,547	35.2	808.0	843.2
C-1	0.774	23,147	57	4,414	4,471	1.0	79.1	80.1
C-1W	0.584	3,644	114	593	707	0.2	1.3	1.5
C-2	0.894	11,364	1,934	4,137	6,071	19.7	42.0	61.7
D-1	0.917	15,043	32,560	85,860	118,420	449.1	1184.4	1633.5
D-2	0.877	18,176	4,598	73,981	78,579	73.3	1,179.3	1252.6
E-1	0.612	9,484	3,444	18,325	21,769	20.0	106.4	126.4
E-1W	0.964	3,033	736	1,729	2,465	2.2	5.0	7.2
TOTAL ENERGY SAVINGS BASED ON BLAST COMPUTER MODEL, SYNERGY ADJUSTED						768.7	5,544.5	6,313.2

W=WINTERIZED

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BUILDING GROUP ENERGY USAGE

NIGHT SET-BACK ONLY

SUB GROUP	STUDY BUILDING	AVERAGE SUB - GROUP BASIC BTU/FT^2 - YR.			AVERAGE SUB - GROUP WITH OPTION BTU/FT^2 - YR.		
		ELECTRIC	FUEL	TOTAL	ELECTRIC	FUEL	TOTAL
A-1	101, 126	83040	119426	202466	77952	69535	14748[illegible]
A-1W	101, 126	49238	17775	67012	45501	6682	5218[illegible]
B-1	SEE B-2						
B-1W	(1528)	34166	20772	54933	33532	15232	48764
B-2	1528	62964	123417	186381	61774	96060	157834
C-1	313	70902	89282	160184	70845	84868	155713
C-1W	313	37791	6057	43848	37677	5464	43141
C-2	1290	102396	38513	140909	100462	54376	134339
D-1	179	273699	225344	499043	241139	139484	380623
D-2	820	142940	468524	611464	138342	394543	53288[illegible]
E-1	821	412543	245961	658504	409099	227636	636735
E-1W	821	229563	78515	308078	228827	76786	305613

W=WINTERIZED

EEA018-0582/0108

WHERE SEVERAL ENERGY CONSERVATION OPTIONS ARE INDEPENDENT OF EACH OTHER, THEIR COMBINED EFFECT IS THE SUM OF THEIR INDIVIDUAL EFFECTS. WHERE OPTIONS ARE DEPENDENT (AFFECTING THE SAME LOAD) THEIR COMBINED EFFECT IS THE PRODUCT OF THEIR INDIVIDUAL FRACTIONAL EFFECT. FOR EXAMPLE IF 2 OPTIONS WILL EACH REDUCE A GIVEN LOAD BY 60%, BOTH OPTIONS WILL NOT ELIMINATE 120% OF THE LOAD. INSTEAD THE NEW LOAD IS $.4 \times .4 = .16$ TIMES THE ORIGINAL LOAD. THE SECOND DEPENDENT OPTION REDUCES THE REMAINING LOAD, FOLLOWING IMPLEMENTATION OF THE FIRST OPTION.

SYNERGY ADJUSTMENT FACTORS, F_S

BUILDING OPTIONS FALL INTO 3 DEPENDENT GROUPS:

- ENVELOPE – CHANGES IN THIS GROUP ARE INDEPENDENT
- SYSTEMS – DEPENDENT AND INDEPENDENT
- OPERATIONS – DEPENDENT AND INDEPENDENT

EVALUATION OF INDIVIDUAL OPTIONS HAS SHOWN THAT ENVELOPE CHANGES ARE GENERALLY THE MOST COST EFFECTIVE. THEY ARE INDEPENDENT; E.G. CHANGES IN WALL INSULATION CHANGE WALL CONDUCTION WITHOUT INFLUENCING CEILING OR WINDOW LOSSES. ENVELOPE CHANGES HAVE EQUAL IMPACT ON BOTH HEATING AND COOLING LOADS.

PROJECT NAME: EEAP	PROJECT PART: SYNERGY	SPEC. DIVISION: ADJUSTMENT FACTORS
DEPARTMENT: MECHANICAL	COMPUTED BY: CTW DATE: 9/16/82	JOB NO: 4917
SHEET NO: OF:	CHECKED BY: DATE:	SHEET NO: OF:

TO ADJUST SAVINGS FROM AN INDIVIDUAL OPTION:

$$\text{ADJUSTED SAVINGS} = \text{SAVINGS} \times \begin{array}{l}\text{FRACTION OF LOAD } (F_S) \\ \text{REMAINING, FOLLOWING} \\ \text{ENVELOPE CHANGES}\end{array}$$

$$F_S = \frac{\text{ADJUSTED HEATING + COOLING LOAD (WITH OPTIONS)}}{\text{UNADJUSTED LOAD (WITHOUT ENVELOPE OPTIONS)}}$$

THE HEATING/COOLING LOADS HAVE BEEN PRESENTED IN FIGURES 2-13A THRU 2-13F AS PERCENTAGES OF THE TOTAL-LOAD. FOR EACH BUILDING GROUP.

SYNERGY ADJUSTMENT ACCOUNTS FOR THE EFFECTS OF PAST AND PROJECTED ENVELOPE ALTERATIONS FROM THE 1975 BASE MODEL.

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DESIGN ANALYSIS

☐ BUDGET
☐ PRELIMINARY
■ FINAL
☐ OTHER ______

PROJECT NAME: EEAP- A.P. HILL	PROJECT PART: SYNERGY	SPEC. DIVISION: ADJUSTMENT FACTORS
DEPARTMENT: MECHANICAL	COMPUTED BY: CTW DATE: 9/28/82	JOB NO: 4417.02
SHEET NO: OF:	CHECKED BY: DATE:	SHEET NO: OF:

BLDG. SUB-GROUP	A-I	A-IW	B-I	B-IW	B-2	C-I
1981 AREA - FT^2	111771	11499	77001	3528	38967	27250
1975 UNIT LOAD - BTU/FT^2	172257	49115	141414	44845	186381	160184
HEATING + COOLING/TOTAL	.859	.697	.725	.465	.771	.679
1981 HEATING + COOLING LOAD	16539	393.6	7895	73.6	5600	2964
ENVELOPE SAVINGS (MBTU)						
PAST STEEL SIDING	613	12.5	866	14.8	32	56
PAST CEILING INSULATION	179	—	55	.3	3	—
PAST STORM WINDOWS	246	9.9	95	.6	—	13
PAST THERMOPANE WINDOWS	65	1.8	12	—	—	—
NEW CEILING INSULATION	2469	42.3	104	1.0	89	71
NEW WALL INSULATION	313	16.2	1270	18.2	879	438
NEW STORM WINDOWS	109	—	87	—	284	51
NEW CAULK/W.STRIP	212	—	142	—	66	41
SYNERGY ADJUSTMENT						
SUB-TOTAL ENVELOPE SAVINGS	4206	77.7	2581	34.9	1353	670
ADJ. 1981 HTG + CLG LOAD	12333	315.9	5314	38.7	4247	2294
F_S = ADJ. LOAD/UNADJ. LOAD	.746	.803	.673	.526	.758	.774

FRM000.0881

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DESIGN ANALYSIS

☐ PRELIMINARY
■ FINAL
☐ OTHER

PROJECT NAME: EEAP - A.P. HILL	PROJECT PART: SYNERGY	SPEC. DIVISION: ADJUSTMENT FACTORS
DEPARTMENT: MECHANICAL	COMPUTED BY: CTW DATE: 9/28/82	JOB NO: 4417.02
SHEET NO: OF:	CHECKED BY: DATE:	SHEET NO: OF:

BLDG. SUB-GROUP	C-1W	C-2	D-1	D-2	E-1	E-1W
1981 AREA - FT²	3644	22221	31997	18176	9484	10089
1975 UNIT LOAD - BTU/FT²	43848	140909	499093	611464	658509	308078
HEATING + COOLING/TOTAL	.256	.409	.713	.572	.302	.131
1981 HEATING + COOLING LOAD	40.9	1281	11385	6357	1886	407.2
ENVELOPE SAVINGS (MBTU)						
PAST STEEL SIDING	5.1	1	349	—	—	12.8
PAST CEILING INSULATION	.6	—	—	—	—	—
PAST STORM WINDOWS	1.0	0	157	—	—	1.8
PAST THERMOPANE WINDOWS	—	—	—	—	—	—
NEW CEILING INSULATION	—	9	198	140	27	—
NEW WALL INSULATION	10.3	116	129	2281	625	—
NEW STORM WINDOWS	—	5	165	227	45	—
NEW CAULK/W.STRIP	—	5	49	133	35	—
SYNERGY ADJUSTMENT						
SUB-TOTAL ENVELOPE SAVINGS	17.0	136	947	781	732	14.6
ADJ. 1981 HTG + CLG LOAD	23.9	1145	10438	5576	1154	392.6
[illegible] = ADJ. LOAD/UNADJ. LOAD	.584	.89[illegible]	.917	.877	.612	.964

REPLACEMENT OF INEFFICIENT LIGHT FIXTURES: ENERGY SAVINGS AND ECONOMIC CALCULATIONS

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ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)

LOCATION: Fort A.P. Hill, Virginia REGION: 3 PROJECT NO.: DACA 31-89-C-0198
PROJECT TITLE: Fort A.P. Hill- Energy Engineering Analysis Program FISCAL YEAR: 1994
DISCRETE PORTION NAME: Replacement of Inefficient Light Fixtures
ANALYSIS DATE: January 1994 ECONOMIC LIFE (YRS) 15 PREPARER: JJS

1. INVESTMENT COSTS:

A. CONSTRUCTION COST	$	111,658	
B. SIOH	$	6,141	
C. DESIGN COST	$	6,699	
D. TOTAL COST (1A+1B+1C)	$	124,499	
E. SALVAGE VALUE OF EXISTING EQUIPMENT			
F. PUBLIC UTILITY COMPANY REBATE			
G. TOTAL INVESTMENT (1D-1E-1F)			$124,499

2. ENERGY SAVINGS (+)/COST(-):

DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS- Oct 1992

ENERGY SOURCE	COST $/MBTU(1)	SAVING(S) MBTU/YR(2)		ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)		DISCOUNTED SAVINGS(5)
A. ELEC	$20.67	1,420.4	$	29,360	11.77	$	345,563
B. DIST	$5.69		$			$	
C. RESID			$			$	
D. NG			$			$	
E. LPG	$7.76		$			$	
F. COAL			$			$	
G. SOLAR			$			$	
H. GEOTH			$			$	
I. BIOMA			$			$	
J. REFUS			$			$	
K. WIND			$			$	
L. OTHER			$			$	
M. DEMAND SAVINGS			$			$	
N. TOTAL		1,420	$	29,360		$	345,563

3. NON ENERGY SAVINGS (+) OR COST (-):

A. ANNUAL RECURRING (+/-)	$2,515		
(1) DISCOUNT FACTOR (TABLE A)		11.12	
(2) DISCOUNTED SAVINGS/COST (3A X 3A1)			$27,967

B. NON RECURRING SAVINGS (+) OR COST (-)

ITEM		SAVINGS(+) COST(-)(1)	YEAR OF OCCUR. (2)	DISCOUNT FACTOR(3)		DISCOUNTED SAVINGS(+)COST(-)(4)
a. Maint. Fl. Fi	$	-4012	7	0.760	$	-3049
b.	$		6		$	
c.	$		9		$	
d. TOTAL		-4012			$	-3049

C. TOTAL NON ENERGY DISCOUNTED SAVINGS (3A2+3Bd4) $24,918

4. SIMPLE PAYBACK 1G/(2N3+3A+(3Bd1/ECONOMIC LIFE)):	3.94 YEARS
5. TOTAL NET DISCOUNTED SAVINGS (2N5+3C):	$370,481
6. SAVINGS TO INVESTMENT RATION (SIR) 5/1G:	2.98
7. ADJUSTED INTERNAL RATE OF RETURN (AIRR):	7.84%

\project\92006\ecip\lfx

CONSTRUCTION COST ESTIMATE	Date Prepared: 3/1/94	
Activity and Location: Energy Savings Opportunity Survey Fort A. P. Hill, Virginia	Constr. Contact No. DACA 31-89-C-0198	I.D. No.
	Estimated By: EAC, P.C.	Category Code
Project: Inefficient Light Fixtures	Status: Final	Job Order No.

ITEM DESCRIPTION	QUANTITY		PRIME CONTRACTOR				SUBCONTRACTOR				TOTAL COST
			MATERIAL COST		LABOR COST		MATERIAL COST		LABOR COST		
SUMMARY	NUMBER	UNIT	UNIT COST	TOTAL	UNIT COST	TOTAL	UNIT COST	TOTAL	UNIT COST	TOTAL	
Subtotal				50,586		28,671					
DIRECT COSTS				50,586		28,671					
SUBTOTAL (DIRECT COSTS)				50,586		28,671					
Material Tax & Labor Taxes			5.0%	2,529	21.0%	6,021	5.0%		21.0%		
Overhead			15.0%	7,588	15.0%	4,301	15.0%		15.0%		
SUBTOTAL				60,703		38,992					
Profit			12.0%	7,284	12.0%	4,679	12.0%		12.0%		
SUBTOTAL				67,988		43,671					
Prime Overhead on Sub							5.0%		5.0%		
SUBTOTAL											
Prime Profit on Sub							5.0%		5.0%		
TOTAL COST				67,988		43,671					111,658

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CONSTRUCTION COST ESTIMATE	Date Prepared: 3/1/94	Reference: 1982 MMM Design/ 1992 R.S. Means
Activity and Location: Energy Savings Opportunity Survey Fort A. P. Hill, Virginia	Constr. Contact No. DACA 31-89-C-0198	I.D. No.
	Estimated By: EAC, P.C.	Category Code
Project: Inefficient Light Fixtures	Status: Final	Job Order No.

ITEM DESCRIPTION	QUANTITY		PRIME CONTRACTOR				SUBCONTRACTOR				TOTAL COST
			MATERIAL COST		LABOR COST		MATERIAL COST		LABOR COST		
	NUMBER	UNIT	UNIT COST	TOTAL	UNIT COST	TOTAL	UNIT COST	TOTAL	UNIT COST	TOTAL	
2 F32 T-8 SURFACE WRAP AROUND	85.00	EA	116.00	9,860	45.00	3,825					13,685
2 F32 T-8 SURFACE WET LABEL	102.00	EA	170.00	17,340	68.00	6,936					24,276
2 F32 T-8 INDUSTRIAL SUSPENDED	8.00	EA	113.00	904	48.00	384					1,288
1 F32 T-8 SURFACE WET LABEL	32.00	EA	160.00	5,120	56.00	1,792					6,912
1 F32 T-8 STRIP WITH REFLECTOR	9.00	EA	95.00	855	36.00	324					1,179
REMOVAL OF EXISTING FIXTURES	586.00				17.00	9,962					9,962
2 F34W Wall Mounted	52.00	EA	85.00	4,420	25.00	1,300					5,720
T-8 Lighting System Retrofit											
2 F32 T-8 SURFACE WRAP AROUND	226.00	EA	51.00	11,526	17.50	3,955					15,481
2 F32 T-8 WET LABEL	11.00	EA	51.00	561	17.50	193					754
SUB - TOTAL				$50,586		$28,671					$79,257

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ENGINEERING ANALYSIS

Sheet 1 of 1

Date: December 7, 1992 By: JS

Project: Energy Savings Opportunity Survey, Fort A.P. Hill, VA

Contract No.: DACA 31-89-C-0198 EAC Project No.: 92008.00

MAINTENANCE COSTS FOR FLOURESCENT FIXTURES OVER LIFE OF PROJECT (15 yrs)

USEFUL LIFE = 7.69 yrs, however practical experience HAS SHOWN LIFE IS REDUCED BECAUSE OF UTILITY LINE DISTURBANCE. Therefore we will use about 7 yrs Avg LIFE.

ANNUAL MAINTENANCE COST (FOR LAMPS) = $\frac{\text{MAT}}{6.00}$ $\frac{\text{LAB}}{1.50}$ = 7.50

$\frac{\$7.50}{\text{LAMP}} \times \frac{535\text{ LAMPS}}{\text{YR}} \cong \$4{,}012$ per LOT 1 change

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ENGINEERING ANALYSIS

Sheet 1 of 1

Date: December 7, 1992 By: JS

Project: Energy Savings Opportunity Survey, Fort A.P. Hill, VA

Contract No.: DACA 31-89-C-0198 EAC Project No.: 92008.00

LAMP ECONOMIC LIFE

F40T12 AVERAGE LIFE = 20,000 HRS

$$\text{OPERATING HOURS} = \frac{10\ \text{HRS}}{\text{DAY}} \times \frac{5\ \text{DAYS}}{\text{WK}} \times \frac{52\ \text{WKS}}{\text{YR}} = 2600\ \text{HRS/YR}$$

$$\text{USEFUL LIFE} = \frac{20{,}000\ \text{HRS}}{2600\ \text{HRS/YR}} = 7.69\ \text{YRS}$$

INCANDESCENT (75 WATT BULB) LIFE = 750 HRS

$$\text{USEFUL LIFE} = \frac{750\ \text{HRS}}{2600\ \text{HR/YR}} = .3\ \text{YRS}$$

ANNUAL MAINTENANCE COSTS:

$$266\ \text{INCANDESCENT} \times \frac{3\ \text{CHANGES}}{\text{YR}} \times \frac{3.15}{\text{BULB}} \cong 2515\ /\text{YR}$$

Replace Ineffient Light Fixtures

Building Group	Study Building	Study Blg Floor Area Ft**2	Total Group Floor Area Ft**2	Incandescent to be Replaced Per Study Building	Proposed Fluorescent Per Study Blg.	Proposed Fluorescent Per Goup
B-2	1528	7,563	38,967	---	46	237
C-2	1290	9,306	9,306	15	13	13
D-2	820	6,176	18,176	37	31	91
E-1	821	5,984	8,484	176	130	184
				228		

Replace Ineffient Light Fixtures- Energy Savings

Building Group	Study Building	Study Blg Floor Area Ft**2	Total Group Floor Area Ft**2	Study Blg. Energy Savings		Group Energy Savings	
				KWH/Ft**2/Yr	Btu/Ft**2/Yr	KWH/Yr.	MBtu/Yr
B-2	1528	7,563	38,967	1.5	5,148.3	58,780	200.6
C-2	1290	9,306	9,306	3.0	10,290.5	28,058	95.8
D-2	820	6,176	18,176	7.4	25,256.9	134,506	459.1
E-1	821	5,984	8,484	23.0	78,371.7	194,816	664.9
							1,420.4

Building 1528

Type of Lamp	# of Lamps	Watts per Lamp	Ballast Usage	KW	Hours/ Week	Weeks/ Month	Months/ Year	KWH/Year	$/KWH	$/Year	
F40 T-12 Fluorescent	88	40	1.25	4.40	168	4.345	12	38,542	0.063	2,428	Standard (Existing)
F32 T-8 Fluorescent	88	32	1.10	3.10	168	4.345	12	27,133	0.063	1,709	Replacement
							Energy Savings	11,408 KWH		719	$ Savings

Building 1290- Mens and Locker Room

Type of Lamp	# of Lamps	Watts per Lamp	Ballast Usage	KW	Hours/ Week	Weeks/ Month	Months/ Year	KWH/Year	$/KWH	$/Year	
Incandescent Lighting	11	100	1.00	1.10	168	4.345	12	9,635	0.063	607	Standard (Existing)
F32 T-8 Fluorescent	10	32	1.10	0.35	168	4.345	12	3,083	0.063	194	Replacement
							Energy Savings	6,552 KWH		413	$ Savings

Building 1290- Parts

Type of Lamp	# of Lamps	Watts per Lamp	Ballast Usage	KW	Hours/ Week	Weeks/ Month	Months/ Year	KWH/Year	$/KWH	$/Year	
Incandescent Lighting	11	300	1.00	3.30	168	4.345	12	28,906	0.063	1,821	Standard (Existing)
F32 T-8 Fluorescent	24	32	1.10	0.84	168	4.345	12	7,400	0.063	466	Replacement
							Energy Savings	21,506 KWH		1,355	$ Savings

Building 820

Type of Lamp	# of Lamps	Watts per Lamp	Ballast Usage	KW	Hours/ Week	Weeks/ Month	Months/ Year	KWH/Year	$/KWH	$/Year	
Incandescent Lighting	74	100	1.00	7.40	168	4.345	12	64,820	0.063	4,084	Standard (Existing)
F32 T-8 Fluorescent	62	32	1.10	2.18	168	4.345	12	19,117	0.063	1,204	Replacement
							Energy Savings	45,704 KWH		2,879	$ Savings

Building 821- Lavs and Toilets

Type of Lamp	# of Lamps	Watts per Lamp	Ballast Usage	KW	Hours/ Week	Weeks/ Month	Months/ Year	KWH/Year	$/KWH	$/Year	
Incandescent Lighting	88	100	1.00	8.80	168	4.345	12	77,084	0.063	4,856	Standard (Existing)
F32 T-8 Fluorescent	84	32	1.10	2.96	168	4.345	12	25,900	0.063	1,632	Replacement
							Energy Savings	51,184 KWH		3,225	$ Savings

Building 821- Drying,Shower, and Mechanical Room Areas

Type of Lamp	# of Lamps	Watts per Lamp	Ballast Usage	KW	Hours/ Week	Weeks/ Month	Months/ Year	KWH/Year	$/KWH	$/Year	
Incandescent Lighting	28	150	1.00	4.20	168	4.345	12	36,790	0.063	2,318	Standard (Existing)
F32 T-8 Fluorescent	26	32	1.10	0.92	168	4.345	12	8,017	0.063	505	Replacement
							Energy Savings	28,773 KWH		1,813	$ Savings

Building 821- Laundry Area

Type of Lamp	# of Lamps	Watts per Lamp	Ballast Usage	KW	Hours/ Week	Weeks/ Month	Months/ Year	KWH/Year	$/KWH	$/Year	
Incandescent Lighting	12	200	1.00	2.40	168	4.345	12	21,023	0.063	1,324	Standard (Existing)
F32 T-8 Fluorescent	6	32	1.10	0.21	168	4.345	12	1,850	0.063	117	Replacement
							Energy Savings	19,173 KWH		1,208	$ Savings

Building 821- Lavatory (Above Basin) Lights

Type of Lamp	# of Lamps	Watts per Lamp	Ballast Usage	KW	Hours/ Week	Weeks/ Month	Months/ Year	KWH/Year	$/KWH	$/Year	
Incandescent Lighting	76	100	1.00	7.60	168	4.345	12	66,572	0.063	4,194	Standard (Existing)
2F40 Wall Mount	76	34	1.25	3.23	168	4.345	12	28,293	0.063	1,782	Replacement
							Energy Savings	38,279 KWH		2,412	$ Savings

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ENGINEERING ANALYSIS

Sheet ____ of ____

By: ____

Inefficient Light Fixtures

Project: Fort A. P. Hill ESOS   Date: 2-28-94

Contract No.: DACA 31-89-C-0198   EAC Project No.: 92008

Blg Subgroup 5-2

Replace Existing 40 watt fluorescent tubes with T-8 lamps and electronic ballast and reuse existing fixture lens & housing.

F-32 T-8 surface Wrap Around - 226
(Parts for Retrofit)
F32 T-8 Wet Label 11
Total 237

44

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ENGINEERING ANALYSIS

Sheet ____ of ____

By: [illegible]

Inefficient Light Fixtures

Project: Fort A. P. Hill ESOS   Date: 2-28-94

Contract No.: DACA 31-89-C-0198   EAC Project No.: 92008

Bldg. Group - C-2   Total Per Group

1. F32T-8 Surface Wrap Around -
2. F32 T-8 Surface Wet Label - 2
3. F32 T-8 Industrial Suspended - 8
4. 1F32 T-8 Surface Wet Label - - 3

2F34 W/ Wall Mounted -

Total 13

45

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ENGINEERING ANALYSIS

Sheet ____ of ____

By: JS

Inefficient Light Fixtures

Project: Fort A. P. Hill ESOS

Date: 2-28-94

Contract No.: DACA 31-89-C-0198

EAC Project No.: 92008

BLg. GROUP - D-2

		TOTAL PER GROUP
1. F32T-8 Surface Wrap Around	-	
2. F32 T-8 Surface WET LABEL	-	91
3. F32 T-8 INDUSTRIAL SUSPENDED	-	
4. 1F32 T-8 SURFACE WET LABEL	-	-
2F34 W WALL MOUNTED	-	

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ENGINEERING ANALYSIS

Sheet ____ of ____

By: JS

Inefficient Light Fixtures

Project: Fort A. P. Hill ESOS   Date: 2-28-94

Contract No.: DACA 31-89-C-0198   EAC Project No.: 92008

BLg. GROUP - E-1

		TOTAL PER GROUP
1.	F32T-8 Surface Wrap Around -	85
2.	F32 T-8 Surface WET LABEL -	9
3.	F32 T-8 INDUSTRIAL SUSPENDED -	
4,	1F32 T-8 SURFACE WET LABEL - -	29
5.	2F34 W WALL MOUNTED -	52
6.	F32 T-3 STRIP W/REFLECTOR	9
		184

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OTHER ______ JOB NO. 941702

PROJECT NAME: EEA

ELECTRICAL DEPT.

SHEET NO. ____ OF ____

PROJECT LOCATION: BLDG 1528

COMPUTED BY: CJA — DATE 2-8-82

LIGHTING CALCULATIONS

CHECKED BY: JGR — DATE 3-11-82

Room Name: BEDROOM # 1

Length: 120' Width: 22' Height: 10.5'

Area: 2967 ft^2 Mounting Height: 8'

% Wall: 50 % Ceiling: 80

Room Index: 2 UF: .63 MF: .75 UFxMF:

Req'd FC: 20 Maintained FC: 19.4

$\frac{FC\ 20 \quad Sq.\ Ft.\ 2967}{UF \times MF\ (.63)(.75)}$ = Lumens 125,590

$\frac{Lumens\ 125590}{Lamp\ Lumens\ 3050}$ = Lamps 41.17

$\frac{Fix's\ 20 \quad Lamps/F\ 2 \quad LL\ 3050 \quad UF \times MF\ (.63)(.75)}{Sq.\ Ft.\ 2967}$ = Maint. FC

Fixture Type: SURFACE WRAPAROUND (2F40) Number of Fixtures: 20

Fixture Spacing: ____ Number of Rows: ____ Total Wattage: 1480 W

Remarks: BEDROOM # 2 IS THE SAME

Room Name: BATHROOM # 1

Length: 18' Width: 12' Height:

Area: 216 ft^2 Mounting Height: 8'

% Wall: 50 % Ceiling: 80

Room Index: 5.5 UF: .42 MF: .75 UFxMF:

Req'd FC: 20 Maintained FC: 18

$\frac{FC\ 20 \quad Sq.\ Ft.\ 216}{UF \times MF\ (.42)(.75)}$ = Lumens

$\frac{Lumens\ 13714}{Lamp\ Lumens\ 3050}$ = Lamps 4.49

$\frac{Fix's\ 2 \quad Lamps/F\ 2 \quad LL\ 3050 \quad UF \times MF\ (.42)(.75)}{Sq.\ Ft.\ 216}$ = Maint. FC

Fixture Type: SURFACE WRAPAROUND (2F40) Number of Fixtures: 2

Fixture Spacing: ____ Number of Rows: ____ Total Wattage: 148 W

Remarks: BATHROOM # 2 IS THE SAME

Room Name: SHOWER

Length: 17' Width: 8' Height:

Area: 136 Mounting Height: 8'

% Wall: 30 % Ceiling: 70

Room Index: 7.35 UF: .26 MF: .75 UFxMF:

Req'd FC: 20 Maintained FC: 17

$\frac{FC\ 20 \quad Sq.\ Ft.\ 136}{UF \times MF\ (.26)(.75)}$ = Lumens

$\frac{Lumens\ 13949}{Lamp\ Lumens\ 3050}$ = Lamps 4.57

$\frac{Fix's\ 2 \quad Lamps/F\ 2 \quad LL\ 3050 \quad UF \times MF\ (.26)(.75)}{Sq.\ Ft.\ 136}$ = Maint. FC

Fixture Type: SURFACE WETLABEL (2F40) Number of Fixtures: 2

Fixture Spacing: ____ Number of Rows: ____ Total Wattage: 148 W

Remarks:

Room Name: ____

Length: ____ Width: ____ Height: ____

Area: ____ Mounting Height: ____

% Wall: ____ % Ceiling: ____

Room Index: ____ UF: ____ MF: ____ UFxMF: ____

Req'd FC: ____ Maintained FC: ____

FC ____ Sq. Ft. ____ / UF x MF = Lumens

Lumens ____ / Lamp Lumens ____ = Lamps

Fix's ____ Lamps/F ____ LL ____ UF x MF ____ / Sq. Ft. ____ = Maint. FC

Fixture Type: ____ Number of Fixtures: 40

Fixture Spacing: ____ Number of Rows: ____ Total Wattage: ____

Remarks:

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ENGINEERING ANALYSIS

Sheet 1 of ____

By: JS

BLdg 1290

Project: Fort A. P. Hill ESOS

Date: 2-28-94

Contract No.: DACA 31-89-C-0198

EAC Project No.: 92008

PROPOSED

MENS ROOM – 2F40 SURFACE WET LABEL – 3 FIXTURES

LOCKER ROOM – 2F40 SURFACE WET LABEL – 2 FIXTURES

PARTS & TOOLS – 2F40 INDUSTRIAL – 2 FIXTURES

EXISTING

MENS ROOM – 5-100W A-19 (INCAND) (5 LAMPS)

LOCKER ROOM – 2-100W A-19 (INCAND) (6 LAMPS)

PARTS & TOOLS – 8 – 300W I.FLOODS

PROPOSED

MENS RM – 2F32-T-8 DAMP LOCATION 3 FIX

LOCKER RM 2 FIX

PARTS & TOOLS 2F32 T-8 INDUSTRIAL – 2 FIX

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ARCHITECTS & CONSULTING ENGINEERS

PROJECT NAME: EFA A.P HILL

JOB NO.

ELECTRICAL DEPT.

SHEET NO. ____ OF ____

PROJECT LOCATION: BLDG 1290

COMPUTED BY: CJA — DATE: 2-8-82

LIGHTING CALCULATIONS

CHECKED BY: SGR — DATE: 3-11-82

Room Name: MENS TOILET
Length: 11' Width: 13' Height: 12.5
Area: 143 ft² Mounting Height: 10'
% Wall: 50 % Ceiling: 50
Room Index: 8 UF: .19 MF: .7 UFxMF:
Req'd FC: 8 Maintained FC: 8.1

FC 8 × Sq. Ft. 142 / UF x MF .133 = Lumens
Lumens 8100 / Lamp Lumens 1750 = Lamps 5
Fix's 5 Lamps/F 1 LL 1750 UF x MF .133 / Sq. Ft. 143 = Maint. FC 8.1

Fixture Type: ART METAL 100 W — Number of Fixtures: 5
Fixture Spacing: — Number of Rows: — Total Wattage: 1000
Remarks: CALCULATION OF EXISTING FC

Room Name: MENS TOILET
Length: 11' Width: 13' Height: 12.5
Area: 143 ft² Mounting Height: 10'
% Wall: 50 % Ceiling: 50
Room Index: 8 UF: .22 MF: .7 UFxMF:
Req'd FC: 10 Maintained FC: 9.8

FC 10 × Sq. Ft. 143 / UF x MF (.22)(.7) = Lumens
Lumens 9286 / Lamp Lumens 3050 = Lamps 3
Fix's 3 Lamps/F 1 LL 3050 UF x MF (.22)(.7) / Sq. Ft. 143 = Maint. FC 9.8

Fixture Type: 1F40 SURFACE WET LABEL — Number of Fixtures: 3
Fixture Spacing: — Number of Rows: — Total Wattage: 222 W
Remarks: PROPOSED

Room Name: LOCKER ROOM
Length: 8' Width: 10' Height: 12.5
Area: 80 ft² Mounting Height: 10'
% Wall: 30 % Ceiling: 50
Room Index: 11 UF: .14 MF: .7 UFxMF:
Req'd FC: 13 Maintained FC: 12.8

FC 13 × Sq. Ft. 80 / UF x MF (.14)(.7) = Lumens 10612
Lumens 10612 / Lamp Lumens 1750 = Lamps 6
Fix's 2 Lamps/F 3 LL 1750 UF x MF (.14)(.7) / Sq. Ft. 80 = Maint. FC 12.8

Fixture Type: ART METAL I.F. 100 W — Number of Fixtures: 2
Fixture Spacing: — Number of Rows: — Total Wattage: 600
Remarks: CALCULATION OF EXISTING FC

Room Name: LOCKER ROOM
Length: 8' Width: 10' Height: 12.5
Area: 80 ft² Mounting Height: 10'
% Wall: 30 % Ceiling: 50
Room Index: 11 UF: .18 MF: .7 UFxMF:
Req'd FC: 15 Maintained FC: 19.2

FC 15 × Sq. Ft. 80 / UF x MF (.18)(.7) = Lumens
Lumens 9524 / Lamp Lumens 3050 = Lamps 3.1
Fix's 2 Lamps/F 2 LL 3050 UF x MF (.18)(.7) / Sq. Ft. 80 = Maint. FC 19.2

Fixture Type: 2F40 SURFACE WET LABEL — Number of Fixtures: 2
Fixture Spacing: — Number of Rows: — Total Wattage: 148 W 42
Remarks: PROPOSED

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PROJECT NAME EEA A.P. HILL			ELECTRICAL DEPT. SHEET NO. ___ OF ___
PROJECT LOCATION BLDG 1290	COMPUTED BY: CJA	DATE 2-8-82	
LIGHTING CALCULATIONS	CHECKED BY: SGR	DATE 3-11-82	

Room Name PARTS & TOOLS
Length 19' Width 19' Height 12'
Area 228 ft^2 Mounting Height 9.5'
% Wall 30 % Ceiling 50
Room Index 6.5 UF .37 MF .65 UFxMF
Req'd FC 54 IES Maintained FC 53.5

FC 54 Sq. Ft. 228 / UF x MF .24 = Lumens 51193
Lumens 51193 / Lamp Lumens 6360 = Lamps 8
Fix's 8 Lamps/F 1 LL 6360 UF x MF .24 / Sq. Ft. 228 = Maint. FC 53.5

Fixture Type I F 300 W Number of Fixtures 8
Fixture Spacing ___ Number of Rows ___ Total Wattage 2400 W
Remarks CALCULATION OF EXISTING FC

Room Name PARTS & TOOLS
Length ___ Width 19' Height 12'
Area 228 ft^2 Mounting Height 9.5
% Wall 30 % Ceiling 50
Room Index 6.5 UF .35 MF .65 UFxMF
Req'd FC 50 Maintained FC 48.7

FC 50 Sq. Ft. 228 / UF x MF .2275 = Lumens
Lumens 50110 / Lamp Lumens 3050 = Lamps 16.4
Fix's 8 Lamps/F 2 LL 3050 UF x MF .2275 / Sq. Ft. 228 = Maint. FC

Fixture Type 2FAD INDUSTRIAL (SUSPENDED) Number of Fixtures 8
Fixture Spacing ___ Number of Rows ___ Total Wattage 592 W
Remarks PROPOSED

Room Name BATTERY ROOM
Length 13' Width 7' Height 12'
Area 91 ft^2 Mounting Height 9.5
% Wall 30 % Ceiling 50
Room Index 10 UF .24 MF .65 UFxMF
Req'd FC 32 IES Maintained FC 31.3

FC 32 Sq. Ft. 91 / UF x MF (.23) (.65) = Lumens 19478
Lumens 19478 / Lamp Lumens 6360 = Lamps 3
Fix's 3 Lamps/F 1 LL 6360 UF x MF (.23)(.65) / Sq. Ft. 91 = Maint. FC 31.3

Fixture Type I.F. 300 W Number of Fixtures 3
Fixture Spacing ___ Number of Rows ___ Total Wattage 900 W
Remarks CALCULATION OF EXISTING FC

Room Name BATTERY ROOM
Length 13' Width 7' Height 12'
Area 91 ft^2 Mounting Height 9.5
% Wall 30 % Ceiling 50
Room Index 10 UF .23 MF .65 UFxMF
Req'd FC 30 Maintained FC 30

FC 30 Sq. Ft. 91 / UF x MF (.23) (.65) = Lumens
Lumens 18261 / Lamp Lumens 3050 = Lamps 6
Fix's 3 Lamps/F 2 LL 3050 UF x MF (.23) (.65) / Sq. Ft. 91 = Maint. FC

Fixture Type ___ Number of Fixtures 3
Fixture Spacing ___ Number of Rows ___ Total Wattage ___
Remarks BECAUSE OF LOW HOURS OF OPERATION WE WILL NOT CHANGE THE LIGHTING

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OTHER ____ JOB NO. 6417.02

PROJECT NAME: FEA

ELECTRICAL DEPT. SHEET NO. ____ OF ____

PROJECT LOCATION: BLDG 820

COMPUTED BY: CJA — DATE

LIGHTING CALCULATIONS

CHECKED BY: SGR — DATE 3-11-82

Room Name: KITCHEN (1)
Length: 35' Width: 16' Height:
Area: 560 ft² Mounting Height: 8'
% Wall: 30 % Ceiling: 70
Room Index: 3.7 UF: .52 MF: .7 UFxMF:
Req'd FC: Maintained FC:

FC 24 Sq. Ft. 560 / UF x MF (.52)(.7) = Lumens 73500
Lumens / Lamp Lumens 1750 = Lamps 42
Fix's 21 Lamps/F 2 LL UF x MF / Sq. Ft. = Maint. FC

Fixture Type: I.F. 100 W — Number of Fixtures: 21
Fixture Spacing: — Number of Rows: — Total Wattage: 4200
Remarks: CALCULATION OF EXISTING FC

Room Name: KITCHEN (1)
Length: Width: Height:
Area: 560 ft² Mounting Height:
% Wall: 30 % Ceiling: 70
Room Index: 3.7 UF: .43 MF: .7 UFxMF:
Req'd FC: 50 Maintained FC:

FC 50 Sq. Ft. 560 / UF x MF .301 = Lumens
Lumens / Lamp Lumens 3050 = Lamps 30
Fix's 15 Lamps/F 2 LL UF x MF / Sq. Ft. = Maint. FC

Fixture Type: 2F40 SURFACE WETLABEL — Number of Fixtures: 15
Fixture Spacing: — Number of Rows: — Total Wattage:
Remarks: PROPOSED

Room Name: KITCHEN (2)
Length: 14' Width: 10' Height:
Area: 140 ft² Mounting Height: 8'
% Wall: 30 % Ceiling: 70
Room Index: 7 UF: .57 MF: .7 UFxMF:
Req'd FC: Maintained FC:

FC 60 Sq. Ft. 140 / UF x MF (.57)(.7) = Lumens 21000
Lumens / Lamp Lumens 1750 = Lamps 12
Fix's Lamps/F 2 LL UF x MF / Sq. Ft. = Maint. FC

Fixture Type: — Number of Fixtures: 6
Fixture Spacing: — Number of Rows: — Total Wattage: 1200
Remarks: CALCULATION OF EXISTING FC

Room Name: KITCHEN (2)
Length: 14' Width: 10' Height:
Area: 140 ft² Mounting Height:
% Wall: 30 % Ceiling: 70
Room Index: 7 UF: .27 MF: .7 UFxMF:
Req'd FC: 50 Maintained FC:

FC 50 Sq. Ft. 140 / UF x MF (.27)(.7) = Lumens
Lumens / Lamp Lumens 3050 = Lamps 12
Fix's 6 Lamps/F 2 LL UF x MF / Sq. Ft. = Maint. FC

Fixture Type: 2F40 SURFASE WETLABEL — Number of Fixtures: 6
Fixture Spacing: — Number of Rows: — Total Wattage: 43
Remarks: PROPOSED

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ENGINEERING ANALYSIS

Sheet ____ of ____

By: JS

Blg 820

Project: Fort A. P. Hill ESOS

Date: 2-28-94

Contract No.: DACA 31-89-C-0198

EAC Project No.: 92008

Space	Existing	Number Fixtures	Number Lamps	Proposed	# Fixtures
Kitchen (1)	100W Flood	21	42	2F40 Wet Label	15
Kitchen (2)	100W Flood	6	12	2F40 Wet Label	6
Kitchen (3)	100W Flood	10	20	2F40 Wet Label	10
		37	74		31

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☐ OTHER

JOB NO. 4417.02

ELECTRICAL DEPT.

SHEET NO. ____ OF ____

PROJECT NAME: FFA

PROJECT LOCATION: BLDG 820

COMPUTED BY: CJA

DATE:

LIGHTING CALCULATIONS

CHECKED BY: SGR

DATE: 3-11-82

Room Name: KITCHEN (2)
Length: 26' Width: 13' Height:
Area: 330 ft Mounting Height: 9'
% Wall: 30 % Ceiling: 70
Room Index: 4.6 UF: .56 MF: .7 UFxMF:
Req'd FC: Maintained FC:

FC 41 × Sq. Ft. 140 / UF x MF (.56)(.7) = Lumens 35000

Lumens / Lamp Lumens 1750 = Lamps 20

Fix's 10 Lamps/F 2 LL UF x MF / Sq. Ft. = Maint. FC

Fixture Type: I F 100 W Number of Fixtures: 10
Fixture Spacing: Number of Rows: Total Wattage: 2000 W
Remarks: CALCULATION OF EXISTING FC

Room Name: KITCHEN (2)
Length: Width: Height:
Area: 338 ft Mounting Height:
% Wall: 30 % Ceiling: 70
Room Index: 4.1 UF: .38 MF: .7 UFxMF:
Req'd FC: 50 Maintained FC:

FC 50 × Sq. Ft. 338 / UF x MF (.38)(.7) = Lumens

Lumens / Lamp Lumens 3050 = Lamps 20 8

Fix's 10 Lamps/F 2 LL UF x MF / Sq. Ft. = Maint. FC

Fixture Type: 2 FAO SURFACE WETLABEL Number of Fixtures: 10
Fixture Spacing: Number of Rows: Total Wattage:
Remarks: PROPOSED

Room Name:
Length: Width: Height:
Area: Mounting Height:
% Wall: % Ceiling:
Room Index: UF: MF: UFxMF:
Req'd FC: Maintained FC:

FC × Sq. Ft. / UF x MF = Lumens

Lumens / Lamp Lumens = Lamps

Fix's Lamps/F LL UF x MF / Sq. Ft. = Maint. FC

Fixture Type: Number of Fixtures:
Fixture Spacing: Number of Rows: Total Wattage:
Remarks:

Room Name:
Length: Width: Height:
Area: Mounting Height:
% Wall: % Ceiling:
Room Index: UF: MF: UFxMF:
Req'd FC: Maintained FC:

FC × Sq. Ft. / UF x MF = Lumens

Lumens / Lamp Lumens = Lamps

Fix's Lamps/F LL UF x MF / Sq. Ft. = Maint. FC

Fixture Type: Number of Fixtures:
Fixture Spacing: Number of Rows: Total Wattage:
Remarks:

44

54

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ENGINEERING ANALYSIS

Sheet ____ of ____

By: JS

BLg 821

Project: Fort A. P. Hill ESOS   Date: 2-28-94

Contract No.: DACA 31-89-C-0198   EAC Project No.: 92008

Space	Exist.	# Fixt.	Proposed	# Fixt.	Total Fixt.
Toilet, Lav's* Urinals	100W	4- ~~80~~ (60) 4	2F40 Surface Wrap Around	4 2-Vestibule	80 4
Shower**	150W	3	1 F40 Surface Wet Label	3	12
Drying (Per Room - 2 Rooms)	150W	4	1 F40 Surface Wet Label	4	8
Laundry (Per Bay - 2 Bays)	200W	6 (6)	2 F40 Surface Wet Label	3	6
Mechanical Room	150W	8	1F40 Strip w/Reflector	6	
					116

* Per Bay — 10 bays
** Per Shower — 4 Showers

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PROJECT NAME: FFA A.P. HILL | JOB NO.
ELECTRICAL DEPT. SHEET NO. ____ OF ____

PROJECT LOCATION: BLDG 821 | COMPUTED BY: CJA | DATE: 1-29-82

LIGHTING CALCULATIONS

CHECKED BY: S.G.R. | DATE: 3-11-82

Room Name: TOILET, LAVATORIES & URINALS, VESTIBULE
Length: 10' Width: 31' Height: 10.5'
Area: 310 ft² Mounting Height: 8'
% Wall: 50 % Ceiling: 50
Room Index: 5.3 UF: .49 MF: .7 UFxMF: .315
Req'd FC: 15 Maintained FC: 15

FC 15 × Sq. Ft. 310 / UF x MF (.49)(.7) = Lumens 13557

Lumens 13557 / Lamp Lumens 1750 = Lamps 7.7

Fix's 4 × Lamps/F 2 × LL 1750 × UF x MF (.49)(.7) / Sq. Ft. 310 = Maint. FC

Fixture Type: ART METAL 602 (100W) Number of Fixtures: 4
FIXT. TYPE IS APPROX. THE SAME AS THE EXISTING ONE
Fixture Spacing: Number of Rows: Total Wattage: 800 W + 400W
Remarks: CALCULATION OF EXISTING FC (PER BAY) (10 BAYS) VESTIB

Room Name: TOILET, LAVATORIES & URINALS
Length: 10' Width: 31' Height: 10.5'
Area: 310 Mounting Height: 8'
% Wall: 50 % Ceiling: 50
Room Index: 5.3 UF: .4 MF: .7 UFxMF: .287
Req'd FC: 15 Maintained FC: 23

FC 15 × Sq. Ft. 310 / UF x MF (.41)(.7) = Lumens

Lumens 16203 / Lamp Lumens 3050 = Lamps 5.3

Fix's 4 × Lamps/F 2 × LL 3050 × UF x MF .287 / Sq. Ft. 310 = Maint. FC 7.3

Fixture Type: 2FAQ SURFACE - WRAPAROUND Number of Fixtures: 4 + 2 = 6 (VESTIBULE)
Fixture Spacing: Number of Rows: Total Wattage: W
Remarks: PROPOSED. (PER BAY) 110 ...)

Room Name: SHOWER
Length: 10' Width: 18' Height: 10.5'
Area: 180 ft² Mounting Height: 8'
% Wall: 30 % Ceiling: 50
Room Index: 6.22 UF: .26 MF: .7 UFxMF:
(FROM IES. - 10%)
Req'd FC: 9 Maintained FC: 8.7

FC 9 × Sq. Ft. 180 / UF x MF (.26)(.7) = Lumens 8901

Lumens 8901 / Lamp Lumens 2880 = Lamps 3

Fix's 3 × Lamps/F 1 × LL 2880 × UF x MF (.26)(.7) / Sq. Ft. 180 = Maint. FC 8.7

Fixture Type: I.F (150W) Number of Fixtures: 3
Fixture Spacing: Number of Rows: Total Wattage: 450 W
Remarks: CALCULATION OF EXISTING FC (PER ROOM) (4 ROOMS)

Room Name: SHOWER
Length: 10' Width: 18' Height: 10.5'
Area: 180 ft² Mounting Height: 8'
% Wall: 30 % Ceiling: 50
Room Index: 6.22 UF: .28 MF: .7 UFxMF: .196
Req'd FC: 9 Maintained FC: 9.9

FC 9 × Sq. Ft. 180 / UF x MF .196 = Lumens 8265

Lumens 8265 / Lamp Lumens 3050 = Lamps 2.7

Fix's 3 × Lamps/F 1 × LL 3050 × UF x MF .196 / Sq. Ft. 180 = Maint. FC 9.9

Fixture Type: 1FAQ SURFACE WET LABEL Number of Fixtures: 3
Fixture Spacing: Number of Rows: Total Wattage: 45
Remarks: PROBOSED (PER ROOM) (4 ROOMS)

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PROJECT NAME: A. P. HILL

ELECTRICAL DEPT.

SHEET NO. ______ OF ______

PROJECT LOCATION: BLDG 821

COMPUTED BY: CJA

DATE: 1-29-82

LIGHTING CALCULATIONS

CHECKED BY: SGR

DATE: 3-11-82

Room Name: DRYING

Length: 21' Width: 12' Height: 10.5'

Area: 252 ft² Mounting Height: 8'

% Wall: 30 % Ceiling: 50

Room Index: 5.23 UF: .26 MF: .7 UF x MF: .224

Req'd FC: 9 TES. Maintained FC: 8.3

FC 9 Sq. Ft. 252 / UF x MF .182 = Lumens 12462

Lumens 12462 / Lamp Lumens 2880 = Lamps 4

Fix's 4 Lamps/F 1 LL 2880 UF x MF .182 / Sq. Ft. 252 = Maint. FC 8.3

Fixture Type: I.F 150 W Number of Fixtures: 4

Fixture Spacing: ______ Number of Rows: ______ Total Wattage: 600 W

Remarks: CALCULATION OF EXISTING FC (PER ROOM) 12 ROOMS)

Room Name: DRYING

Length: 21' Width: 12' Height: 10.5'

Area: 252 Mounting Height: 8'

% Wall: 30 % Ceiling: 50

Room Index: 5.23 UF: .32 MF: .7 UF x MF: .224

Req'd FC: 9 Maintained FC: 11

FC 9 Sq. Ft. 252 / UF x MF .224 = Lumens

Lumens 10125 / Lamp Lumens 3050 = Lamps 3.3

Fix's 4 Lamps/F 1 LL 3050 UF x MF .224 / Sq. Ft. 252 = Maint. FC

Fixture Type: 1F40 SURFACE WETLABOL Number of Fixtures: 4

Fixture Spacing: ______ Number of Rows: ______ Total Wattage: ______

Remarks: PROPOSED (PER ROOM) 12 ROOMS)

Room Name: LAUNDRY

Length: 10' Width: 31' Height: 10.5'

Area: 310 Mounting Height: 8'

% Wall: 30 % Ceiling: 50

Room Index: 5.3 UF: .24 MF: .7 UF x MF: .168

Req'd FC: 9.36 Maintained FC: 9.3

FC 9.36 Sq. Ft. 310 / UF x MF .168 = Lumens

Lumens 17271 / Lamp Lumens 2880 = Lamps 6

Fix's 6 Lamps/F 1 LL 2880 UF x MF .168 / Sq. Ft. 310 = Maint. FC 9.3

Fixture Type: 200 W Number of Fixtures: 6

Fixture Spacing: ______ Number of Rows: ______ Total Wattage: 1200W

Remarks: CALC. OF EXISTING FC (PER BAY) 12 BAYS)

Room Name: LAUNDRY

Length: 10' Width: 31' Height: 10.5'

Area: 310 Mounting Height: 8'

% Wall: 30 % Ceiling: 50

Room Index: 5.3 UF: .32 MF: .7 UF x MF: .168

Req'd FC: 10 Maintained FC: 9.9

FC 10 Sq. Ft. 310 / UF x MF .168 = Lumens 18452.

Lumens 18452 / Lamp Lumens 3050 = Lamps 6

Fix's 3 Lamps/F 2 LL 3050 UF x MF .168 / Sq. Ft. 310 = Maint. FC 9.9

Fixture Type: 2F40 SURFACE WETLABEL Number of Fixtures: 3

Fixture Spacing: ______ Number of Rows: ______ Total Wattage: 46

Remarks: PROPOSED (PER BAY) 12 BAYS)

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PROJECT NAME: FFA

JOB NO. 5417.02

ELECTRICAL DEPT.

SHEET NO. ____ OF ____

PROJECT LOCATION: BLDG 621

COMPUTED BY: CJA — DATE 1-29-82

LIGHTING CALCULATIONS

CHECKED BY: SGR — DATE 3-11-82

Room Name MECHANICAL EQU. ROOM

Length 21' Width 31' Height 10.5'

Area 651 ft² Mounting Height 8'

% Wall 30 % Ceiling 50

Room Index 3.2 UF .34 MF .65 UFxMF

Req'd FC 8 T.F.S Maintained FC 7.8

FC 8 Sq. Ft. 651 / UF x MF .221 = Lumens 23566

Lumens 23566 / Lamp Lumens 2880 = Lamps 8.1

Fix's 8 Lamps/F 1 LL 2880 UF x MF .221 / Sq. Ft. 651 = Maint. FC 7.8

Fixture Type I.F 150W Number of Fixtures 8

Fixture Spacing ____ Number of Rows ____ Total Wattage 1200W

Remarks CALCULATION OF EXISTING FC

Room Name MECHANICAL EQU ROOM

Length 21' Width 31' Height 10.5'

Area 651 ft² Mounting Height 8'

% Wall 30 % Ceiling 50

Room Index 3.2 UF .58 MF .65 UFxMF .377

Req'd FC 10 Maintained FC 10.6

FC 10 Sq. Ft. 651 / UF x MF .377 = Lumens

Lumens 17268 / Lamp Lumens 3050 = Lamps 5.66

Fix's 6 Lamps/F 1 LL 3050 UF x MF .377 / Sq. Ft. 651 = Maint. FC 10.6

Fixture Type LF40 STRIP WITH REFLECTOR Number of Fixtures 6

Fixture Spacing ____ Number of Rows ____ Total Wattage ____

Remarks PROPOSED

Room Name ____

Length ____ Width ____ Height ____

Area ____ Mounting Height ____

% Wall ____ % Ceiling ____

Room Index ____ UF ____ MF ____ UFxMF ____

Req'd FC ____ Maintained FC ____

FC ____ Sq. Ft. ____ / UF x MF = Lumens

Lumens / Lamp Lumens = Lamps

Fix's ____ Lamps/F ____ LL ____ UF x MF ____ / Sq. Ft. = Maint. FC

Fixture Type ____ Number of Fixtures ____

Fixture Spacing ____ Number of Rows ____ Total Wattage ____

Remarks

Room Name ____

Length ____ Width ____ Height ____

Area ____ Mounting Height ____

% Wall ____ % Ceiling ____

Room Index ____ UF ____ MF ____ UFxMF ____

Req'd FC ____ Maintained FC ____

FC ____ Sq. Ft. ____ / UF x MF = Lumens

Lumens / Lamp Lumens = Lamps

Fix's ____ Lamps/F ____ LL ____ UF x MF ____ / Sq. Ft. = Maint. FC

Fixture Type ____ Number of Fixtures ____

Fixture Spacing ____ Number of Rows ____ Total Wattage ____ 47

Remarks

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DESIGN ANALYSIS

- [x] BUDGET
- [ ] PRELIMINARY
- [ ] FINAL
- [ ] OTHER

PROJECT NAME: EEA	PROJECT PART: A.P. HILL BLDG Q21	SPEC. DIVISION:
DEPARTMENT: ELE.	COMPUTED BY: C.JA DATE: 1-29-82	JOB NO:
SHEET NO: OF:	CHECKED BY: DATE:	SHEET NO: OF:

LAVATORY (ABOVE BASIN) LIGHTS

THERE EXISTS 10 ROWS OF 6 INCANDESCENT FIXTURES AND 2 ROWS OF 8 INCANDESCENT FIXTURES.
EACH ROW IS 12 FEET LONG, EACH FIXTURE HAS ONE 100W LAMP. WHICH PROVIDES 1750 LUMENS.
TOTAL WATTAGE = 7600 W

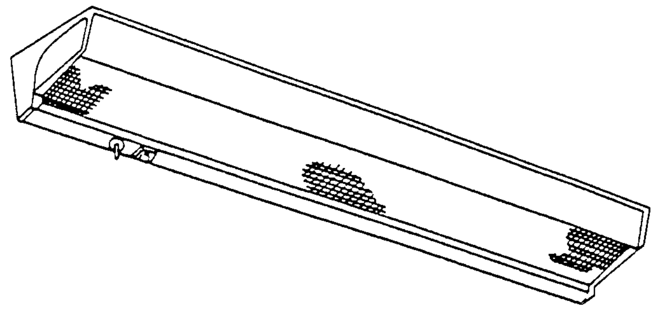
THEREFORE, EXISTING LUMEN PER LINEAR FOOT IS,

$$\frac{(1750 \frac{LUMENS}{FIXT.})(6\ FIXT)}{12\ LINEAR\ FEET} = 876\ LUMENS/LINEAR\ FOOT$$

REPLACE THE INCANDESCENT LIGHTING W/2 F34 WALL MOUNTED FIXTURES.

FMA034.0481/0108

2F34 WALL MOUNTED FIXTURES FOR USE IN BLG 821
Above Basin in LAVATORY.



TYPE 223
Two Lamps

Enclosed, Wall Mounted, Direct And/Or Indirect
Fluorescent Fixture

Fixture shall be constructed of cold-rolled steel and shall conform to UL 1570. Ferrous metal surfaces shall be treated with 5-stage coating of zinc phosphate and finished in baked white enamel. Seams shall be sealed or gasketed to prevent light leakage. The lens shall be 0.125 inch nominal thickness (minimum 0.115 inch) of 100 percent virgin clear acrylic plastic, with a regular array of prismatic elements on one surface and smooth on the other. Receptacle shall be 2-pole, 3-wire, rated at 15 amperes and 125 volts, and shall be of the grounding type. On/off pull chain switch shall be provided for downlight. Upward light shall be controlled from a wall switch. Fixture shall have knockouts in the back for wiring through an outlet box and a grounding terminal. Standard ballast shall be the Class P, high power factor type which has been approved for the application by the Certified Ballast Manufacturers. Fixture shall be prewired.

Fixture type indicated on this sheet shall also conform to requirements specified and indicated in the contract documents.

DESIGN ANALYSIS

■ BUDGET
☐ PRELIMINARY
☐ FINAL
☐ OTHER

PROJECT NAME: EFA	PROJECT PART: FORT HILL	SPEC. DIVISION: INEFFICIENT LIGHT FIXTURES
DEPARTMENT: ELECTRICAL	COMPUTED BY: CJA DATE: 5-7-82	JOB NO: 4417.02
SHEET NO: OF:	CHECKED BY: DATE:	SHEET NO: OF:

APPLICABLE BUILDINGS

GROUP B-2	GROUP C-2	GROUP D-2	GROUP E-1
# 253	# 1290	# 820	# 305
1526		1525	306
1528			821
1529			
1532			
1533			

FM066.0681/0109

CEILING INSULATION: ENERGY SAVINGS AND ECONOMIC CALCULATIONS

LIFE CYCLE COST ANALYSIS SUMMARY
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)

LOCATION: Fort A.P. Hill, Virginia REGION: 3 PROJECT NO.: DACA 31-89-C-0198
PROJECT TITLE: Fort A.P. Hill- Energy Engineering Analysis Program FISCAL YEAR: 1994
DISCRETE PORTION NAME: Ceiling Insulation
ANALYSIS DATE: January 1994 ECONOMIC LIFE (YRS) 20 PREPARER: JJS

1. INVESTMENT COSTS:

A. CONSTRUCTION COST	$	125,160	
B. SIOH	$	6,884	
C. DESIGN COST	$	7,510	
D. TOTAL COST (1A+1B+1C)	$	139,553	
E. SALVAGE VALUE OF EXISTING EQUIPMENT			
F. PUBLIC UTILITY COMPANY REBATE			
G. TOTAL INVESTMENT (1D-1E-1F)			$139,553

2. ENERGY SAVINGS (+)/COST(-):

DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS- Oct 1992

ENERGY SOURCE	COST $/MBTU(1)	SAVING(S) MBTU/YR(2)		ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)		DISCOUNTED SAVINGS(5)
A. ELEC	$20.67	10.7	$	221	14.65	$	3,240
B. DIST	$5.69	2,340.9	$	13,320	17.70	$	235,759
C. RESID			$			$	
D. NG			$			$	
E. LPG	$7.76		$			$	
F. COAL			$			$	
G. SOLAR			$			$	
H. GEOTH			$			$	
I. BIOMA			$			$	
J. REFUS			$			$	
K. WIND			$			$	
L. OTHER			$			$	
M. DEMAND SAVINGS			$			$	
N. TOTAL		2,352	$	13,541		$	238,999

3. NON ENERGY SAVINGS (+) OR COST (-):

A. ANNUAL RECURRING (+/-)
(1) DISCOUNT FACTOR (TABLE A)
(2) DISCOUNTED SAVINGS/COST (3A X 3A1)

B. NON RECURRING SAVINGS (+) OR COST (-)

ITEM		SAVINGS(+) COST(-)(1)	YEAR OF OCCUR. (2)	DISCOUNT FACTOR(3)		DISCOUNTED SAVINGS(+)COST(-)(4)
a.	$				$	
b.	$				$	
c.	$				$	
d. TOTAL					$	

C. TOTAL NON ENERGY DISCOUNTED SAVINGS (3A2+3Bd4)

4. SIMPLE PAYBACK 1G/(2N3+3A+(3Bd1/ECONOMIC LIFE)): 10 YEARS
5. TOTAL NET DISCOUNTED SAVINGS (2N5+3C): $238,999
6. SAVINGS TO INVESTMENT RATION (SIR) 5/1G: 1.71
7. ADJUSTED INTERNAL RATE OF RETURN (AIRR): 2.84%

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CONSTRUCTION COST ESTIMATE

Date Prepared: 1/27/94

Activity and Location:
Energy Savings Opportunity Survey
Fort A. P. Hill, Virginia

Constr. Contact No. DACA 31-89-C-0198

I.D. No.

Estimated By: EAC, P.C.

Category Code

Project: Ceiling Insulation

Status: Final

Job Order No.

ITEM DESCRIPTION	QUANTITY		PRIME CONTRACTOR				SUBCONTRACTOR				TOTAL COST
			MATERIAL COST		LABOR COST		MATERIAL COST		LABOR COST		
SUMMARY	NUMBER	UNIT	UNIT COST	TOTAL	UNIT COST	TOTAL	UNIT COST	TOTAL	UNIT COST	TOTAL	
Subtotal				49,950		38,095					
DIRECT COSTS				49,950		38,095					
SUBTOTAL (DIRECT COSTS)				49,950		38,095					
Material Tax & Labor Taxes			5.0%	2,498	21.0%	8,000	5.0%		21.0%		
Overhead			15.0%	7,493	15.0%	5,714	15.0%		15.0%		
SUBTOTAL				59,940		51,810					
Profit			12.0%	7,193	12.0%	6,217	12.0%		12.0%		
SUBTOTAL				67,133		58,027					
Prime Overhead on Sub							5.0%		5.0%		
SUBTOTAL											
Prime Profit on Sub							5.0%		5.0%		
TOTAL COST				67,133		58,027					125,160

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CONSTRUCTION COST ESTIMATE			Date Prepared: 1/27/94				Reference: MMM Design Group 1982/ R.S. Means 1992				
Activity and Location: Energy Savings Opportunity Survey Fort A. P. Hill, Virginia			Constr. Contact No. DACA 31-89-C-0198				I.D. No.				
			Estimated By: EAC, P.C.				Category Code				
Project: Ceiling Insulation			Status: Final				Job Order No.				
ITEM DESCRIPTION	QUANTITY		PRIME CONTRACTOR				SUBCONTRACTOR				TOTAL COST
			MATERIAL COST		LABOR COST		MATERIAL COST		LABOR COST		
	NUMBER	UNIT	UNIT COST	TOTAL	UNIT COST	TOTAL	UNIT COST	TOTAL	UNIT COST	TOTAL	
GROUP A-1	73,043	SF	0.214	15,646	0.164	11,964					27,610
GROUP A-1 (WINTERIZED)	9,565	SF	0.214	2,049	0.164	1,567					3,616
GROUP B-1	33,501	SF	0.214	7,176	0.164	5,487					12,663
GROUP B-1 (WINTERIZED)	2,740	SF	0.214	587	0.164	449					1,036
GROUP B-2	36,663	SF	0.214	7,853	0.164	6,005					13,859
GROUP C-1	24,226	SF	0.214	5,189	0.164	3,968					9,157
GROUP C-1 (WINTERIZED)	260	SF	0.214	56	0.164	43					98
GROUP C-2	3,315	SF	0.214	710	0.133	441					1,151
GROUP D-1	22,222	SF	0.214	4,760	0.164	3,640					8,400
GROUP D-1 (WINTERIZED)											
GROUP D-2	18,176	SF	0.214	3,893	0.164	2,977					6,871
GROUP E-1	9,484	SF	0.214	2,031	0.164	1,553					3,585
GROUP E-1 (WINTERIZED)											
SUB - TOTAL				$49,950		$38,095					$88,046

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ANALYSIS

☐ PRELIMINARY
☐ FINAL
☐ OTHER

PROJECT NAME: FORT A.P. HILL E.E.A.	PROJECT PART: CEILING INSULATION	SPEC. DIVISION: COST ESTIMATE
DEPARTMENT: Architectural	COMPUTED BY: CTW DATE: 9/27/82	JOB NO: 4417.02
SHEET NO: OF:	CHECKED BY: DATE:	SHEET NO: OF:

A	B	C	D	E=D÷C	F	G=ExF
SUB GROUP	BUILDING NUMBER	FLOOR AREA - S.F.	PROJECT AREA - FT^2	RATIO	UNIT COST	COST PER FT^2 OF FLOOR AREA
A-1	101	5080	5080	1.00	(SEE COST ESTIMATE SHEETS)	G ≡ F TYPICAL
A-1	126	2490	2490	1.00		
B-1	311	3247	3247	1.00		
B-2	1528	7563	7563	1.00		
C-1	313	5171	5171	1.00		
C-2	1290	9306	9306	1.00		
D-1	179	6275	6275	1.00		
D-2	820	6176	6176	1.00		
E-1	821	5984	5984	1.00		

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ENGINEERING ANALYSIS

Sheet ____ of ____

By: JS

Ceiling INSULATION

Project: Fort A. P. Hill ESOS Date: 2-28-94

Contract No.: DACA 31-89-C-0198 EAC Project No.: 92008

	M	L
KRAFT FACED BAT INSULATION (R-19)	0.39	0.133
MINERAL FIBER BLOWN INSULATION (R-19) (Includes Cutting & PATCHING)	0.204	0.119
4 MIL POLYETHYLENE VAPOR BARRIER	0.010	0.045

BUILDING GROUP ENERGY SAVINGS
CEILING/ATTIC INSULATION

SUB GROUP	STUDY BUILDING	APPLIED GROUP (SQ-FT)	AVERAGE SUB-GROUP SAVINGS BTU/FT^2-YR			TOTAL SUB-GROUP SAVINGS MBTU/YR		
			ELECTRIC	FUEL	TOTAL	ELECTRIC	FUEL	TOTAL
A-1	101,126	73,043	-139	23,830	23,691	-10.1	1,741.1	1,731.0
A-1W	101,126	9,565	-530	4,952	4,442	-5.1	47.4	42.3
B-1	311	33,501	-	2,342	2,342	-	78.4	78.4
B-1W	311	2,740	-	370	370	-	1.0	1.0
B-2	1528	36,663	-	2,354	2,354	-	89.0	89.0
C-1	313	24,226	39	2,561	2,600	1.1	62.0	63.1
C-1W	313	260	-	172	172	-	0	0
C-2	313	3,315	39	2,561	2,600	0.1	8.5	8.6
D-1	820	22,222	566	7,141	7,707	12.5	158.6	171.1
D-2	820	18,176	566	7,141	7,707	10.3	129.8	140.1
E-1	821	9,484	199	2,650	0	1.9	25.1	27.0
TOTAL ENERGY SAVINGS						10.7	2,340.9	2,351.6

BUILDING GROUP ENERGY USAGE

CEILING INSULATION ONLY

SUB GROUP	STUDY BUILDING	AVERAGE SUB - GROUP BASIC BTU/FT² - YR.			AVERAGE SUB - GROUP WITH OPTION BTU/FT² - YR.		
		ELECTRIC	FUEL	TOTAL	ELECTRIC	FUEL	TOTAL
A-1	101,126	83040	119426	202466	83179	95596	178775
A-1W	101,126	49238	17775	67013	49768	12823	62591
B-1	311	22298	90360	112658	22298	87988	110286
B-1W	311	10471	9055	19526	10471	8685	19156
B-2	1528	62964	123417	186381	62964	121063	184027
C-1	313	70902	89282	160184	70863	86721	157584
C-1W	313	37791	6057	43848	37791	5885	43676
C-2	SEE C-1						
D-1	SEE D-2						
D-2	820	142940	468524	611464	142374	461383	603756
E-1	821	412543	245961	658504	412344	243311	655655

W=WINTERIZED

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DESIGN ANALYSIS

☒ BUDGET
☐ PRELIMINARY
☐ FINAL
☐ OTHER ______

PROJECT NAME: EEAP - A.P. HILL	PROJECT PART: CEILING INSULATION	SPEC. DIVISION:
DEPARTMENT: MECHANICAL	COMPUTED BY: CTW DATE: 9/24/82	JOB NO: 4417.02
SHEET NO: OF:	CHECKED BY: DATE:	SHEET NO: OF:

CEILING / ATTIC INSULATION
INVOLVED BUILDINGS:

102	158	322	352	1201
103		323	353	1206
104		324	354	1213
105		325	356	1214
		326	357	1220
109		327	358	1221
113	214	328	359	1222
115		329	360	
116		330	361	1225
120		331	361	
121	219	332	362	1227
122	220	333	363	1231
123	224	334	364	1262
		335	501	1282
	227	336	506	1291
	250	337	705	1301
		338	707	1401
129	258	339	708	1501
		340	803	1535 ~~1525~~
135	304	341	808	1526
136	305	342	811	1527
	306	343	812	1528
139		344	813	1529
140	309	345	814	1532
	310	346	815	1533
144	311	347	816	1601
145	312	348	817	1622
148	~~313~~	349	818	2001
149	320	350	820	9071
151	321	351	821	801

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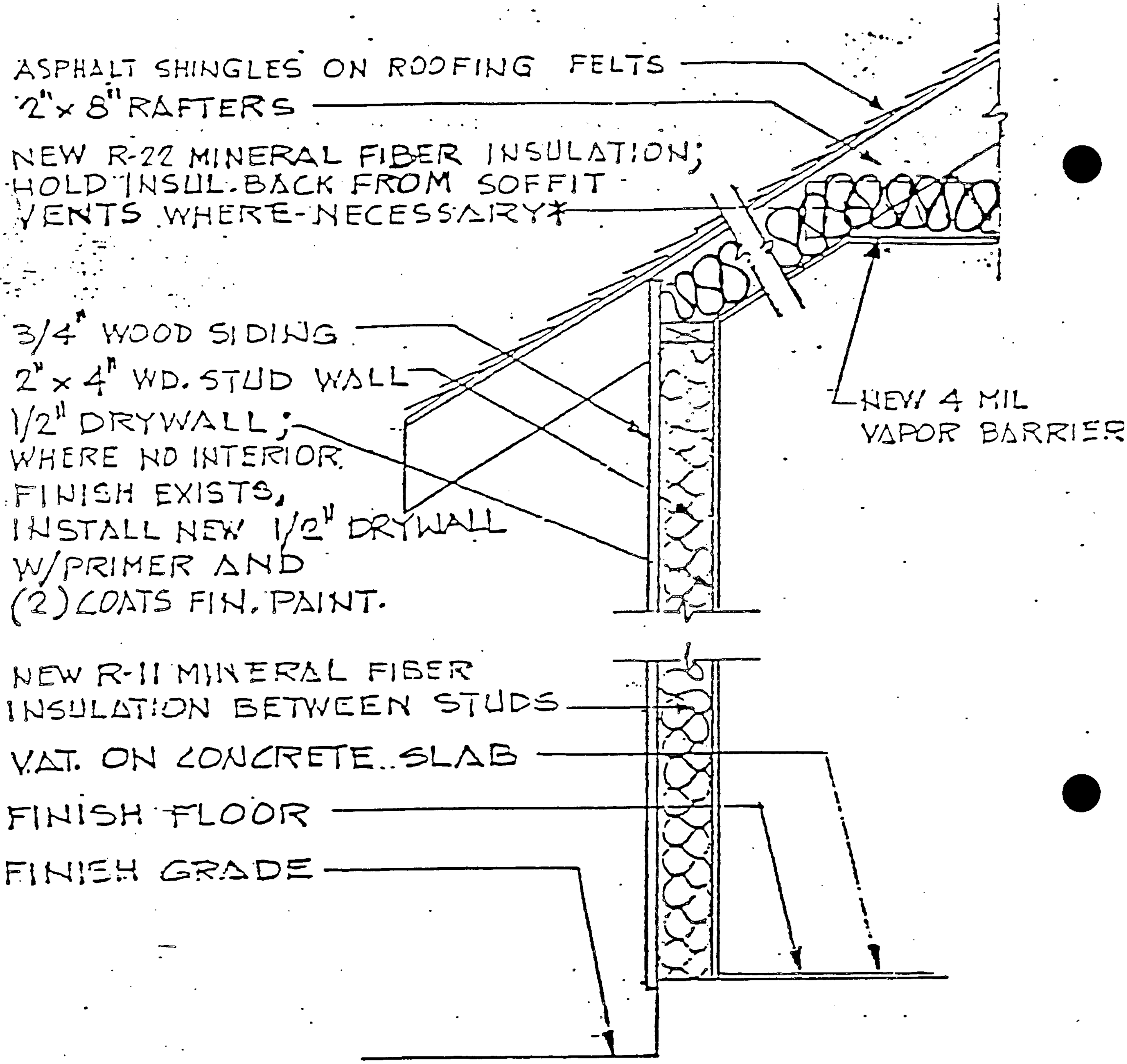

TYPICAL CEILING INSULATION INSTALLATION

* APPLIES TO BUILDINGS WITH ENCLOSED ATTIC SPACE.

7.4 WOOD FRAME WALL INSULATION: ENERGY SAVINGS AND ECONOMIC CALCULATIONS

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LIFE CYCLE COST ANALYSIS SUMMARY
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)

LOCATION: Fort A.P. Hill, Virginia REGION: 3 PROJECT NO.: DACA 31-89-C-0198
PROJECT TITLE: Fort A.P. Hill- Energy Engineering Analysis Program FISCAL YEAR: 1994
DISCRETE PORTION NAME: Wall Insulation
ANALYSIS DATE: January 1994 ECONOMIC LIFE (YRS) 20 PREPARER: JJS

1. INVESTMENT COSTS:

A. CONSTRUCTION COST	$ 181,623	
B. SIOH	$ 9,989	
C. DESIGN COST	$ 10,897	
D. TOTAL COST (1A+1B+1C)	$ 202,510	
E. SALVAGE VALUE OF EXISTING EQUIPMENT		
F. PUBLIC UTILITY COMPANY REBATE		
G. TOTAL INVESTMENT (1D-1E-1F)		$202,510

2. ENERGY SAVINGS (+)/COST(-):

DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS- Oct 1992

ENERGY SOURCE	COST $/MBTU(1)	SAVING(S) MBTU/YR(2)	ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELEC	$20.67	47.0	$ 971	14.65	$ 14,232
B. DIST	$5.69	1,949.5	$ 11,093	17.70	$ 196,340
C. RESID			$		$
D. NG			$		$
E. LPG	$7.76		$		$
F. COAL			$		$
G. SOLAR			$		$
H. GEOTH			$		$
I. BIOMA			$		$
J. REFUS			$		$
K. WIND			$		$
L. OTHER			$		$
M. DEMAND SAVINGS			$		$
N. TOTAL		1,997	$ 12,064		$ 210,572

3. NON ENERGY SAVINGS (+) OR COST (-):

A. ANNUAL RECURRING (+/-)
(1) DISCOUNT FACTOR (TABLE A)
(2) DISCOUNTED SAVINGS/COST (3A X 3A1)

B. NON RECURRING SAVINGS (+) OR COST (-)

ITEM	SAVINGS(+) COST(-)(1)	YEAR OF OCCUR. (2)	DISCOUNT FACTOR(3)	DISCOUNTED SAVINGS(+)COST(-)(4)
a.	$			$
b.	$			$
c.	$			$
d. TOTAL				$

C. TOTAL NON ENERGY DISCOUNTED SAVINGS (3A2+3Bd4)

4. SIMPLE PAYBACK 1G/(2N3+3A+(3Bd1/ECONOMIC LIFE)):	16.79 YEARS
5. TOTAL NET DISCOUNTED SAVINGS (2N5+3C):	$210,572
6. SAVINGS TO INVESTMENT RATION (SIR) 5/1G:	1.04
7. ADJUSTED INTERNAL RATE OF RETURN (AIRR):	0.20%

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CONSTRUCTION COST ESTIMATE	Date Prepared: 1/27/94	
Activity and Location: Energy Savings Opportunity Survey Fort A. P. Hill, Virginia	Constr. Contact No. DACA 31-89-C-0198	I.D. No.
	Estimated By: EAC, P.C.	Category Code
Project: Wall Insulation	Status: Final	Job Order No.

ITEM DESCRIPTION	QUANTITY		PRIME CONTRACTOR				SUBCONTRACTOR				TOTAL COST
			MATERIAL COST		LABOR COST		MATERIAL COST		LABOR COST		
SUMMARY	NUMBER	UNIT	UNIT COST	TOTAL	UNIT COST	TOTAL	UNIT COST	TOTAL	UNIT COST	TOTAL	
Subtotal				30,717		92,134					
DIRECT COSTS				30,717		92,134					
SUBTOTAL (DIRECT COSTS)				30,717		92,134					
Material Tax & Labor Taxes			5.0%	1,536	21.0%	19,348	5.0%		21.0%		
Overhead			15.0%	4,608	15.0%	13,820	15.0%		15.0%		
SUBTOTAL				36,861		125,303					
Profit			12.0%	4,423	12.0%	15,036	12.0%		12.0%		
SUBTOTAL				41,284		140,339					
Prime Overhead on Sub							5.0%		5.0%		
SUBTOTAL											
Prime Profit on Sub							5.0%		5.0%		
TOTAL COST				41,284		140,339					181,623

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CONSTRUCTION COST ESTIMATE			Date Prepared: 1/27/94				Referance: MMM Design 1982/ R.S. Means 1992				
Activity and Location: Energy Savings Opportunity Survey Fort A. P. Hill, Virginia			Constr. Contact No. DACA 31-89-C-0198				I.D. No.				
			Estimated By: EAC, P.C.				Category Code				
Project: Wall Insulation			Status: Final				Job Order No.				
ITEM DESCRIPTION	QUANTITY		PRIME CONTRACTOR				SUBCONTRACTOR				
			MATERIAL COST		LABOR COST		MATERIAL COST		LABOR COST		
	NUMBER	UNIT	UNIT COST	TOTAL	UNIT COST	TOTAL	UNIT COST	TOTAL	UNIT COST	TOTAL	TOTAL COST
GROUP A-1	23,147	SF	0.164	3,796	0.493	11,411					15,208
GROUP A-1 (WINTERIZED)	9,565	SF	0.164	1,569	0.493	4,716					6,284
GROUP B-1	33,501	SF	0.308	10,318	0.923	30,921					41,240
GROUP B-1 (WINTERIZED)	3,528	SF	0.308	1,087	0.923	3,256					4,343
GROUP B-2											
GROUP C-1	19,986	SF	0.505	10,093	1.515	30,279					40,372
GROUP C-1 (WINTERIZED)	3,644	SF	0.505	1,840	1.515	5,521					7,361
GROUP C-2											
GROUP D-1	13,166	SF	0.153	2,014	0.458	6,030					8,044
GROUP D-1 (WINTERIZED)											
GROUP D-2											
GROUP E-1											
GROUP E-1 (WINTERIZED)											
SUB - TOTAL				$30,717		$92,134					$122,852

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ENGINEERING ANALYSIS

Sheet 1 of 1

Date: December 7, 1992 By: JS

Project: Energy Savings Opportunity Survey, Fort A.P. Hill, VA

Contract No.: DACA 31-89-C-0198 EAC Project No.: 92008.00

R. S. MEANS - 1992

MINERAL FIBER BLOWN IN INSULATION:

R = 11

	LAB	MAT
INS.	.15	.20
DRILLING & PATCHING	.60	.05
	.75	.25

TOTAL $1.00 /SF.

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DESIGN ANALYSIS

☐ PRELIMINARY
☐ FINAL
☐ OTHER

PROJECT NAME: FORT A.P. HILL E.E.A.	PROJECT PART: MINERAL FIBER WALL INSULATION	SPEC. DIVISION: COST ESTIMATE
DEPARTMENT: Architectural	COMPUTED BY: CTW DATE: 9/21/82	JOB NO: 4417.02
SHEET NO: OF:	CHECKED BY: DATE:	SHEET NO: OF:

A	B	C	D	E=D÷C	F	G=ExF
SUB GROUP	BUILDING NUMBER	FLOOR AREA - S.F.	PROJECT AREA - FT^2	RATIO	UNIT COST	COST PER FT^2 OF FLOOR AREA
A-1	101	5080	2314	.455	L ~~.33~~ .75 M ~~.22~~ .25	.341 ~~.150~~ ~~.100~~ .113
A-1	126	2490	2139	.860	L ~~.33~~ .75 M ~~.22~~ .25	.645 ~~.283~~ ~~.189~~ .215
B-1	311	3247	3991	1.23	L ~~.33~~ .75 M ~~.22~~ .25	.923 ~~.406~~ ~~.270~~ .3[illegible]
B-2	1528	7563				
C-1	313	5171	10456	2.02	L ~~.33~~ .75 M ~~.22~~ .25	1.515 ~~.667~~ ~~.445~~ .505
C-2	1290	9306				
D-1	179	6275	3827	.610	L ~~.33~~ .75 M ~~.22~~ .25	.458 ~~.201~~ ~~.134~~ .153
D-2	820	6176				
E-1	821	5984				

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DESIGN ANALYSIS

☐ BUDGET
☐ PRELIMINARY
☒ FINAL
☐ OTHER

PROJECT NAME: EEAP - A P HILL	PROJECT PART: WALL INSULATION	SPEC. DIVISION:
DEPARTMENT: MECHANICAL	COMPUTED BY: CTW DATE: 9/20/82	JOB NO: 4417.02
SHEET NO: OF:	CHECKED BY: DATE:	SHEET NO: OF:

MINERAL FIBER INSULATION BLOWN IN WALL

INVOLVED BUILDINGS:

	330	349	813
	331	350	814
250	332	351	815
	333	352	816
	334	353	817
309	335	354	818
310	336	355	1206
311	337	356	1214
313	338	357	1220
320	339	358	1221
321	340	359	1226
322	341	360	1231
323	342	361	1262
324	343	362	1282
325	344	363	1527
326	345	364	2001
327	346	808	9071
328	347	811	
329	348	812	

121	224	708	WINTERIZED
122	227	801	
123	506	1201	
142	707	1205	

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BUILDING GROUP ENERGY SAVINGS
WALL INSULATION

SUB GROUP	STUDY BUILDING	APPLIED GROUP (SQ-FT)	AVERAGE SUB-GROUP SAVINGS BTU/FT^2-YR			TOTAL SUB-GROUP SAVINGS MBTU/YR		
			ELECTRIC	FUEL	TOTAL	ELECTRIC	FUEL	TOTAL
A-1	101,126, 214	23,147	215	9,585	9,800	5.0	222.0	227.0
A-1W	101,126, 214	9,565	189	1,509	1,698	1.8	14.4	16.2
B-1	311	33,501	370	34,186	34,556	12.3	1,145.5	1,157.8
B-1W	311	3,528	277	4,867	5,144	1.0	17.2	18.2
C-1	313	19,986	1,147	20,768	21,915	23.8	415.1	438.0
C-1W	313	3,644	325	2,484	2,809	1.2	9.1	10.3
D-1	101, 126 214	13,166	215	9,585	9,800	2.8	126.2	129.0
TOTAL ENERGY SAVINGS						47.0	1,949.5	1,996.5

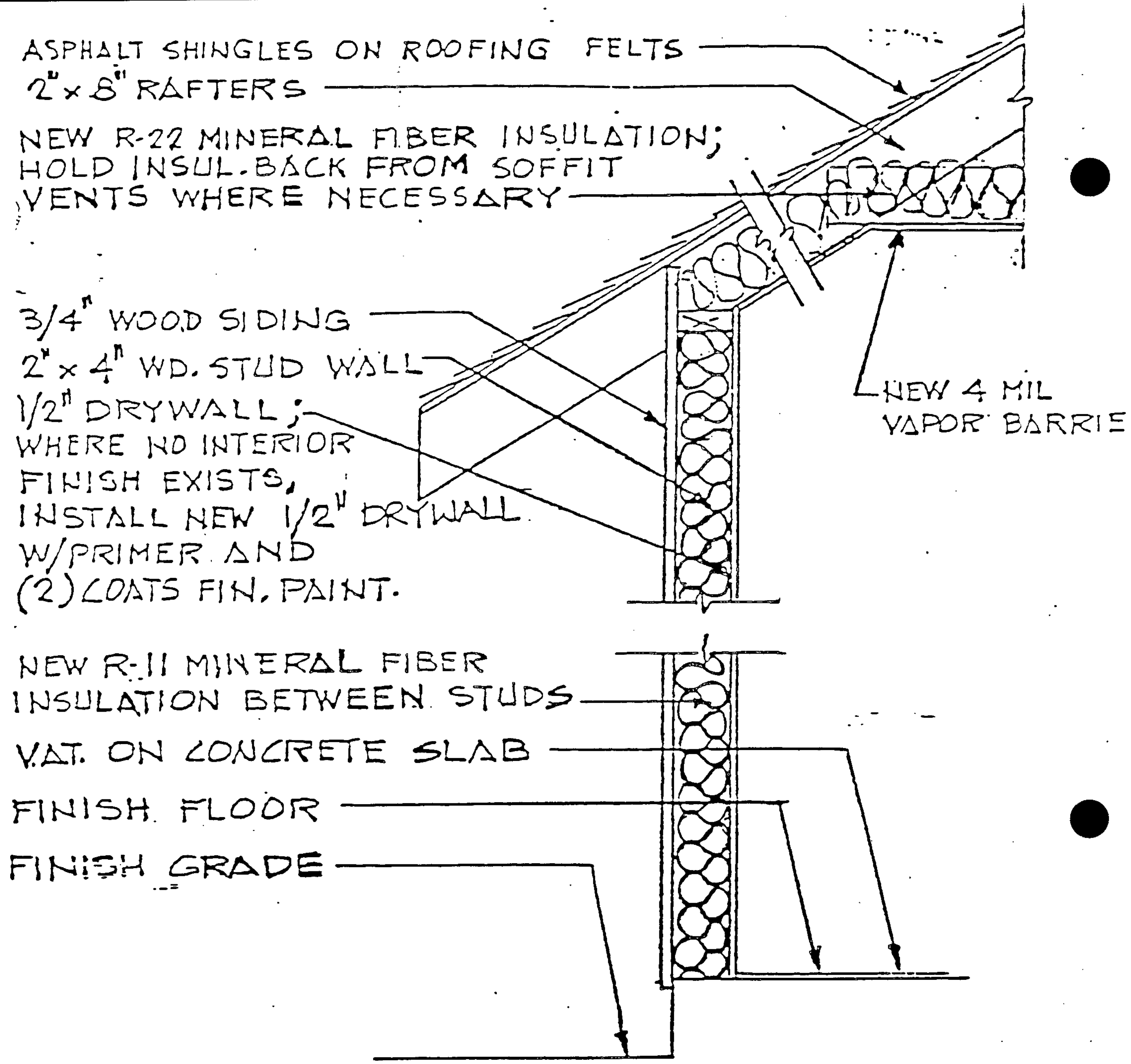
BUILDING G OUP ENERGY USAGE

WALL INSULATION ONLY

SUB GROUP	STUDY BUILDING	AVERAGE SUB - GROUP BASIC BTU/FT^2 - YR.			AVERAGE SUB - GROUP WITH OPTION BTU/FT^2 - YR.		
		ELECTRIC	FUEL	TOTAL	ELECTRIC	FUEL	TOTAL
A-1	101,126,214	57948	114309	172257	57733	104724	162457
A-1W	101,126,214	33620	15495	49115	33431	13986	47417
B-1	311	22298	90330	112658	21928	56144	78072
B-1W	311	10471	9055	19526	10194	4188	14382
C-1	313	70902	89282	160184	69755	68514	138269
C-1W	313	37791	6057	43848	37466	3573	41039
D-1	SEE A-1						

W = WINTERIZED

EEA018-0582/0103



TYPICAL WALL INSULATION INSTALLATION

* APPLIES TO WOOD FRAME BUILDINGS.

CMU WALL INSULATION: ENERGY SAVINGS AND ECONOMIC CALCULATIONS

LIFE CYCLE COST ANALYSIS SUMMARY
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)

LOCATION: Fort A.P. Hill, Virginia REGION: 3 PROJECT NO.: DACA 31-89-C-0198
PROJECT TITLE: Fort A.P. Hill- Energy Engineering Analysis Program FISCAL YEAR: 1994
DISCRETE PORTION NAME: Exterior Wall Insulation for Masonry Walls
ANALYSIS DATE: January 1994 ECONOMIC LIFE (YRS) 20 PREPARER: JJS

1. INVESTMENT COSTS:

A. CONSTRUCTION COST	$	356,789	
B. SIOH	$	19,623	
C. DESIGN COST	$	21,407	
D. TOTAL COST (1A+1B+1C)	$	397,820	
E. SALVAGE VALUE OF EXISTING EQUIPMENT			
F. PUBLIC UTILITY COMPANY REBATE			
G. TOTAL INVESTMENT (1D-1E-1F)			$397,820

2. ENERGY SAVINGS (+)/COST(-):

DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS- Oct 1992

ENERGY SOURCE	COST $/MBTU(1)	SAVING(S) MBTU/YR(2)		ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)		DISCOUNTED SAVINGS(5)
A. ELEC	$20.67	285.5	$	5,901	14.65	$	86,454
B. DIST	$5.69	3,563.0	$	20,273	17.70	$	358,840
C. RESID			$			$	
D. NG			$			$	
E. LPG	$7.76		$			$	
F. COAL			$			$	
G. SOLAR			$			$	
H. GEOTH			$			$	
I. BIOMA			$			$	
J. REFUS			$			$	
K. WIND			$			$	
L. OTHER			$			$	
M. DEMAND SAVINGS			$			$	
N. TOTAL		3,849	$	26,175		$	445,294

3. NON ENERGY SAVINGS (+) OR COST (-):

A. ANNUAL RECURRING (+/-)
(1) DISCOUNT FACTOR (TABLE A)
(2) DISCOUNTED SAVINGS/COST (3A X 3A1)

B. NON RECURRING SAVINGS (+) OR COST (-)

ITEM		SAVINGS(+) COST(-)(1)	YEAR OF OCCUR. (2)	DISCOUNT FACTOR(3)		DISCOUNTED SAVINGS(+)COST(-)(4)
a.	$				$	
b.	$				$	
c.	$				$	
d. TOTAL					$	

C. TOTAL NON ENERGY DISCOUNTED SAVINGS (3A2+3Bd4)

4. SIMPLE PAYBACK 1G/(2N3+3A+(3Bd1/ECONOMIC LIFE)):	15.20 YEARS
5. TOTAL NET DISCOUNTED SAVINGS (2N5+3C):	$445,294
6. SAVINGS TO INVESTMENT RATION (SIR) 5/1G:	1.12
7. ADJUSTED INTERNAL RATE OF RETURN (AIRR):	0.59%

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CONSTRUCTION COST ESTIMATE	Date Prepared: 1/27/94	
Activity and Location: Energy Savings Opportunity Survey Fort A. P. Hill, Virginia	Constr. Contact No. DACA 31-89-C-0198	I.D. No.
	Estimated By: EAC, P.C.	Category Code
Project: Exterior Wall Insulation	Status: Final	Job Order No.

ITEM DESCRIPTION	QUANTITY		PRIME CONTRACTOR				SUBCONTRACTOR				TOTAL COST
			MATERIAL COST		LABOR COST		MATERIAL COST		LABOR COST		
SUMMARY	NUMBER	UNIT	UNIT COST	TOTAL	UNIT COST	TOTAL	UNIT COST	TOTAL	UNIT COST	TOTAL	
Subtotal				129,943		119,581					
DIRECT COSTS				129,943		119,581					
							10.0%				
SUBTOTAL (DIRECT COSTS)				129,943		119,581					
Material Tax & Labor Taxes			5.0%	6,497	21.0%	25,112	5.0%		21.0%		
Overhead			15.0%	19,491	15.0%	17,937	15.0%		15.0%		
SUBTOTAL				155,931		162,630					
Profit			12.0%	18,712	12.0%	19,516	12.0%		12.0%		
SUBTOTAL				174,643		182,146					
Prime Overhead on Sub							5.0%		5.0%		
SUBTOTAL											
Prime Profit on Sub							5.0%		5.0%		
TOTAL COST				174,643		182,146					356,789

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CONSTRUCTION COST ESTIMATE

Activity and Location: Energy Savings Opportunity Survey Fort A. P. Hill, Virginia	Date Prepared: 1/27/94
	Constr. Contact No. DACA 31-89-C-0198
	Estimated By: EAC, P.C.
Project: Exterior Wall Insulation	Status: Final
I.D. No.	
Category Code	
Job Order No.	

ITEM DESCRIPTION	QUANTITY		PRIME CONTRACTOR				SUBCONTRACTOR				TOTAL COST
			MATERIAL COST		LABOR COST		MATERIAL COST		LABOR COST		
	NUMBER	UNIT	UNIT COST	TOTAL	UNIT COST	TOTAL	UNIT COST	TOTAL	UNIT COST	TOTAL	
GROUP A-1											
GROUP A-1 (WINTERIZED)											
GROUP B-1											
GROUP B-1 (WINTERIZED)											
GROUP B-2	36,663	SF	1.410	51,695	1.300	47,662					99,357
GROUP C-1											
GROUP C-1 (WINTERIZED)											
GROUP C-2	20,964	SF	1.750	36,687	1.620	33,962					70,649
GROUP D-1											
GROUP D-1 (WINTERIZED)											
GROUP D-2	18,176	SF	1.530	27,809	1.410	25,628					53,437
GROUP E-1	9,484	SF	1.450	13,752	1.300	12,329					26,081
GROUP E-1 (WINTERIZED)											
SUB - TOTAL				$129,943		$119,581					$249,524

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ANALYSIS

☐ PRELIMINARY
☐ FINAL
☐ OTHER ______

PROJECT NAME: FORT A.P. HILL E.E.A.	PROJECT PART: EXTERIOR WALL INSUL.	SPEC. DIVISION: COST ESTIMATE
DEPARTMENT: Architectural	COMPUTED BY: CTW DATE: 9/23/82	JOB NO: 4417.02
SHEET NO: OF:	CHECKED BY: DATE:	SHEET NO: OF:

A	B	C	D	E=D÷C	F	G=ExF
SUB GROUP	BUILDING NUMBER	FLOOR AREA - S.F.	PROJECT AREA - FT^2	RATIO	UNIT COST	COST PER FT^2 OF FLOOR AREA
A-1	101	5080				
A-1	126	2490				
B-1	311	3247				
B-2	1528	7563	4567	.604	[illegible] L ~~1.56~~ M ~~1.68~~ [illegible]	[illegible] L ~~0.942~~ M ~~1.015~~ [illegible]
C-1	313	5171				
C-2	1290	9306	6964	.748	[illegible] L 1.56 M 1.68 [illegible]	[illegible] L ~~1.167~~ M ~~1.257~~ 1.75
D-1	179	6275				
D-2	820	6176	4028	.652	L 1.56 M 1.68	1.41 L ~~1.017~~ M ~~1.095~~ 1.53
E-1	821	5984	3712	.620	L 1.56 M 1.68	[illegible] L ~~0.967~~ M ~~1.042~~ 1.45

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EAC STANDARD FORM
JULY 1985

ENGINEERING ANALYSIS

Sheet 1 of 1

By: JS

Project: ESOS FORT A P HILL Date: 1/8/92

Contract No.: DACA 31-91-D-0147 EAC Project No.: 92008

EXTERIOR Applied integrated stucco FINISH W/exp POLYSTYRENE INSULATION; R=12.5

LABOR	MATERIAL	TOTAL
\$2.16/FT²	\$2.34/FT²	\$4.50/FT²

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DESIGN ANALYSIS

☐ BUDGET
☐ PRELIMINARY
☒ FINAL
☐ OTHER ______

PROJECT NAME: EEAP - A P HILL	PROJECT PART: WALL INSULATION	SPEC. DIVISION:
DEPARTMENT: MECHANICAL	COMPUTED BY: CTW DATE: 9/21/82	JOB NO: 4417.02
SHEET NO: OF:	CHECKED BY: DATE:	SHEET NO: OF:

EXTERIOR APPLICATION OF EXPANDED POLYSTYRENE WITH INTEGRATED STUCCO FINISH

INVOLVED BUILDINGS:

151	821	1525	1533
	1290	1526	1545
305	1291	1528	1546
306	1326	1529	1622
820	1327	1532	

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BUILDING GROUP ENERGY SAVINGS
EXTERIOR WALL INSULATION

SUB GROUP	STUDY BUILDING	APPLIED GROUP (SQ-FT)	AVERAGE SUB-GROUP SAVINGS BTU/FT^2-YR			TOTAL SUB-GROUP SAVINGS MBTU/YR		
			ELECTRIC	FUEL	TOTAL	ELECTRIC	FUEL	TOTAL
B-2	1528	36,663	132	22,425	22,557	4.8	822.2	827.0
C-2	1290	20,964	1,688	3,826	5,514	35.4	80.2	115.6
D-2	820	18,176	9,957	115,529	125,486	181.0	2,099.9	2,280.8
E-1	821	9,484	6,788	59,128	65,916	64.4	560.7	625.1
TOTAL ENERGY SAVINGS							3,563.0	3,848.5

REPLACEMENT OF INEFFICIENT SITE LIGHTING: ENERGY SAVINGS AND ECONOMIC CALCULATIONS

LIFE CYCLE COST ANALYSIS SUMMARY

ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)

LOCATION: Fort A.P. Hill, Virginia REGION: 3 PROJECT NO.: DACA 31-89-C-0198

PROJECT TITLE: Fort A.P. Hill- Energy Engineering Analysis Program FISCAL YEAR: 1994

DISCRETE PORTION NAME: Replacement of Inefficient Site Lighting

ANALYSIS DATE: January 1994 ECONOMIC LIFE (YRS) 15 PREPARER: JJS

1. INVESTMENT COSTS:

A. CONSTRUCTION COST	$	77,690	
B. SIOH	$	4,273	
C. DESIGN COST	$	4,661	
D. TOTAL COST (1A+1B+1C)	$	86,624	
E. SALVAGE VALUE OF EXISTING EQUIPMENT			
F. PUBLIC UTILITY COMPANY REBATE			
G. TOTAL INVESTMENT (1D-1E-1F)			$86,624

2. ENERGY SAVINGS (+)/COST(-):

DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS- Oct 1992

ENERGY SOURCE	COST $/MBTU(1)	SAVING(S) MBTU/YR(2)	ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELEC	$20.67	334.2	$ 6,908	11.77	$ 81,306
B. DIST	$5.69		$		$
C. RESID			$		$
D. NG			$		$
E. LPG	$7.76		$		$
F. COAL			$		$
G. SOLAR			$		$
H. GEOTH			$		$
I. BIOMA			$		$
J. REFUS			$		$
K. WIND			$		$
L. OTHER			$		$
M. DEMAND SAVINGS			$		$
N. TOTAL		334	$ 6,908		$ 81,306

3. NON ENERGY SAVINGS (+) OR COST (-):

A. ANNUAL RECURRING (+/-)

(1) DISCOUNT FACTOR (TABLE A)

(2) DISCOUNTED SAVINGS/COST (3A X 3A1)

B. NON RECURRING SAVINGS (+) OR COST (-)

ITEM	SAVINGS(+) COST(-)(1)	YEAR OF OCCUR. (2)	DISCOUNT FACTOR(3)	DISCOUNTED SAVINGS(+)COST(-)(4)
a.LPS Repl.	$ 7160	5	0.820	$ 5871
b.Mer.Vap. Re	$ -3379	6	0.790	$ -2670
c.LPS Repl.	$ 7160	10	0.680	$ 4868
d.Mer.Vap. Re	$ -3379	12	0.620	$ -2095
e. TOTAL	7560			$ 5974

C. TOTAL NON ENERGY DISCOUNTED SAVINGS (3A2+3Be4) $5,974

4. SIMPLE PAYBACK 1G/(2N3+3A+(3Bd1/ECONOMIC LIFE)): 11.69 YEARS

5. TOTAL NET DISCOUNTED SAVINGS (2N5+3C): $87,280

6. SAVINGS TO INVESTMENT RATION (SIR) 5/1G: 1.01

7. ADJUSTED INTERNAL RATE OF RETURN (AIRR): 0.05%

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CONSTRUCTION COST ESTIMATE	Date Prepared: 1/27/94	
Activity and Location: Energy Savings Opportunity Survey Fort A. P. Hill, Virginia	Constr. Contact No. DACA 31-89-C-0198 Estimated By: EAC, P.C.	I.D. No. Category Code
Project: Street Lighting	Status: Final	Job Order No.

ITEM DESCRIPTION	QUANTITY		PRIME CONTRACTOR				SUBCONTRACTOR				TOTAL COST
			MATERIAL COST		LABOR COST		MATERIAL COST		LABOR COST		
SUMMARY	NUMBER	UNIT	UNIT COST	TOTAL	UNIT COST	TOTAL	UNIT COST	TOTAL	UNIT COST	TOTAL	
Subtotal				46,075		10,350					
DIRECT COSTS				46,075		10,350					
SUBTOTAL (DIRECT COSTS)				46,075		10,350					
Material Tax & Labor Taxes			5.0%	2,304	21.0%	2,174	5.0%		21.0%		
Overhead			15.0%	6,911	15.0%	1,553	15.0%		15.0%		
SUBTOTAL				55,290		14,076					
Profit			12.0%	6,635	12.0%	1,689	12.0%		12.0%		
SUBTOTAL				61,925		15,765					
Prime Overhead on Sub							5.0%		5.0%		
SUBTOTAL											
Prime Profit on Sub							5.0%		5.0%		
TOTAL COST				61,925		15,765					77,690

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CONSTRUCTION COST ESTIMATE

Activity and Location:
Energy Savings Opportunity Survey
Fort A. P. Hill, Virginia

Project: Street Lighting

Date Prepared: 1/27/94

Constr. Contact No. DACA 31-89-C-0198

Estimated By: EAC, P.C.

Status: Final

I.D. No.

Category Code

Job Order No.

ITEM DESCRIPTION	QUANTITY		PRIME CONTRACTOR				SUBCONTRACTOR				TOTAL COST
			MATERIAL COST		LABOR COST		MATERIAL COST		LABOR COST		
	NUMBER	UNIT	UNIT COST	TOTAL	UNIT COST	TOTAL	UNIT COST	TOTAL	UNIT COST	TOTAL	
135 Watt Low Pressure Sodium Retrofit	90.00	EA	485.00	43,650	115.00	10,350					54,000
Truck Rental (1 week)	1.00	EA	2,425.00	2,425							2,425
SUB - TOTAL				$46,075		$10,350					$56,425

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(703) 978-0923

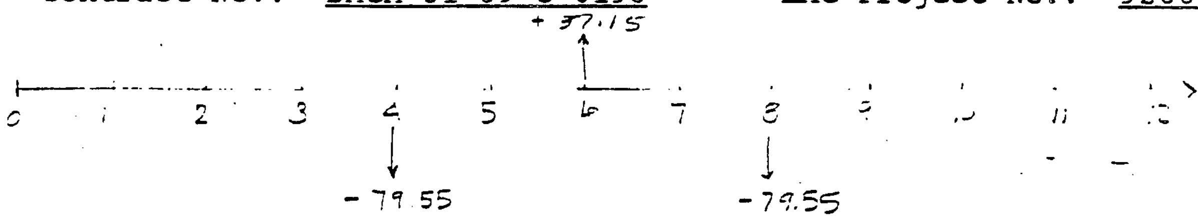
ENGINEERING ANALYSIS

Sheet 1 of 1

Date: December 7, 1992 By: JS

Project: Energy Savings Opportunity Survey, Fort A.P. Hill, VA

Contract No.: DACA 31-89-C-0198 EAC Project No.: 92008.00



COST IN FY75

	M	L	T	
[illegible] MV	[illegible]	[illegible]	$37.15\,(1+.04)^3 = 41.79$	
[illegible] LPS	[illegible]	[illegible]	$79.55\,(1+.04)^3 = 89.46$	

* FOR ECIP ANALYSIS ASSUME LPS TO BE COST (−) AND MV TO BE SAVINGS (+).

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DESIGN ANALYSIS

☐ BUDGET
☐ PRELIMINARY
☐ FINAL
☐ OTHER

PROJECT NAME: EEA	PROJECT PART: FORT HILL	SPEC. DIVISION: STREET LIGHTING
DEPARTMENT: ELECTRICAL	COMPUTED BY: CJA DATE: 3/18/92	JOB NO: 4417-02
SHEET NO: OF:	CHECKED BY: DATE:	SHEET NO: OF:

FOLLOWING TABLE ADDRESSES EXISTING STREET LIGHTS PROPOSED TO BE REPLACED WITH LIGHTS HAVING SIMILAL LUMEN OUTPUT.

	EXISTING					PROPOSED					
LAMP TYPE	FIX. #	WATTS / LAMP	WATTS / FIX.	TOTAL WATT. (KW)	LAMP LUMENS	LAMP TYPE	FIX #	WATTS / LAMP	WATTS / FIX.	TOTAL WATT. (KW)	LAMP LUMENS
MERCURY VAPOR	90	400	450	40.5	22000	LOW PRESSERE SODIUM	90	135	178	16.02	22500

MERCURY VAVOR LAMP LIFE IS 24000 HOURS
LOW PRESSURE SODIUM LAMP LIFE IS 18000 HOURS
FIGURING 4000 BURNING HOURS PER YEAR:

$$(40.5\,KW - 16.02\,KW)(4000\,HRS.)\left(\frac{3{,}413\ BTU}{KWH}\right) =$$

$= \underline{334.2\ MBTU}$ SAVED PER YEAR

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DESIGN ANALYSIS

- ■ BUDGET
- ☐ PRELIMINARY
- ☐ FINAL
- ☐ OTHER

PROJECT NAME: EEA	PROJECT PART: FORT HILL	SPEC. DIVISION: EXISTING STREET LIGHTING
DEPARTMENT: ELEC	COMPUTED BY: CJA DATE: 3/17/82	JOB NO: 4417.02
SHEET NO: 1 OF: 2	CHECKED BY: DATE:	SHEET NO: OF:

LIGHTS HQS. AREA
6 MERCURY VAPORS ON CLOCK, 400 W
7 MERCURY VAPORS EA. 1 PHOTO CONTROL, 400W
8 LOW PRESSURE SODIUM EA. 1 ON PHOTO CONTROL, 135

LIGHTS ANDERSON CAMPSITE
10 LOW PRESSURE SODIUM 1 PHOTO CONTROL, 135 W

LIGHTS OLD GUARD CAMP SITE
15 LOW PRESSURE SODIUM 1 CLOCK, 135 W

LIGHTS RODES CAMPSITE
3 LOW PRESSURE SODIUM EA. PHOTO CONTROL, 135 W
15 LOW PRESSURE SODIUM ON 1 PHOTO CONTROL, 135 W
1 MERCURY VAPOR ON PHOTO CONTROL 400 W

LIGHTS WILCOX
14 MERCURY VAPOR ON 4 PHOTO CONTROLS, 400 W
9 MERCURY VAPOR ON 3 CLOCKS 400 W

WILCOX LAGOON
3 MERCURY VAPOR ON 1 PHOTO CONTROL, 400 W

HEATH AREA
9 LOW PRESSURE SODIUM ON 2 PHOTO CONTROL, 135 W
LIGHTS LIBERTY CAMPSITE
5 LOW PRESSURE SODIUM 1 PHOTO CONTROL, 135 W

LIGHTS MAHONE CAMPSITE
5 LOW PRESSURE SODIUM 1 PHOTO CONTROL, 135 W

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DESIGN ANALYSIS

■ BUDGET
☐ PRELIMINARY
☐ FINAL
☐ OTHER ______

PROJECT NAME: EEA	PROJECT PART: FORT HILL	SPEC. DIVISION: EXISTING STREET LIGHTING
DEPARTMENT: ELECTRICAL	COMPUTED BY: CTA DATE: 3/17/82	JOB NO: 4417.02
SHEET NO: 2 OF: 2	CHECKED BY: DATE:	SHEET NO: OF:

LIGHTS RAPP. CAMPSITE

11 LOW PRESSURE SODIUM 1 PHOTO CONTROL, 135W

2 MERCURY VAPOR EA. 1 ON PHOTO CONTROL 400W

LIGHTS PENDER CAMPSITE

10 LOW PRESSURE SODIUM 1 PHOTO CONTROL, 135W

LIGHTS DAVIS CAMPSITE

14 LOW PRESSURE SODIUM 1 PHOTO CONTROL, 135W

LIGHTS ARCHER CAMPSITE

9 LOW PRESSURE SODIUM 1 PHOTO CONTROL, 135W

LIGHTS COOKE CAMPSITE

10 LOW PRESSURE SODIUM 1 PHOTO CONTROL, 135W

ENG. WAREHOUSE AREA

4 LOW PRESSURE SOD. EA 1 ON PHOTO CONTROL, 135W

EP 4 COMPOUND

40 MERCURY VAPOR 20 UNHOOKED, 400W

ENG. OFFICE

2 MERCURY VAPOR EA. 1 ON PHOTO CONTROL, 400W

LIGHTS NIGHT VISION

6 MERCURY VAPOR EA. 1 ON PHOTO CONTROL, 400W

1 LOW PRE. SOD. 1 PHOTO CONTROL, 135W

	WATTS/FIXTURE	QUANDITY	TOTAL (W) WATT.
MERCURY VAPOR	400 W	90	36000
LOW PRESSURE SODIUM	135 W	130	17550
			5355[illegible] W

WEATHERSTRIPPING AND CAULKING: ENERGY SAVINGS AND ECONOMIC CALCULATIONS

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LIFE CYCLE COST ANALYSIS SUMMARY
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)

LOCATION: Fort A.P. Hill, Virginia REGION: 3 PROJECT NO.: DACA 31-89-C-0198
PROJECT TITLE: Fort A.P. Hill- Energy Engineering Analysis Program FISCAL YEAR: 1994
DISCRETE PORTION NAME: Caulking and Weatherstripping
ANALYSIS DATE: January 1994 ECONOMIC LIFE (YRS) 20 PREPARER: JJS

1. INVESTMENT COSTS:

A. CONSTRUCTION COST	$	59,895	
B. SIOH	$	3,294	
C. DESIGN COST	$	3,594	
D. TOTAL COST (1A+1B+1C)	$	66,783	
E. SALVAGE VALUE OF EXISTING EQUIPMENT			
F. PUBLIC UTILITY COMPANY REBATE			
G. TOTAL INVESTMENT (1D-1E-1F)			$66,783

2. ENERGY SAVINGS (+)/COST(-):

DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS- Oct 1992

ENERGY SOURCE	COST $/MBTU(1)	SAVING(S) MBTU/YR(2)	ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELEC	$20.67	15.1	$ 312	14.65	$ 4,573
B. DIST	$5.69	669.1	$ 3,807	17.70	$ 67,387
C. RESID			$		$
D. NG			$		$
E. LPG	$7.76		$		$
F. COAL			$		$
G. SOLAR			$		$
H. GEOTH			$		$
I. BIOMA			$		$
J. REFUS			$		$
K. WIND			$		$
L. OTHER			$		$
M. DEMAND SAVINGS			$		$
N. TOTAL		684	$ 4,119		$ 71,960

3. NON ENERGY SAVINGS (+) OR COST (-):

A. ANNUAL RECURRING (+/-)
(1) DISCOUNT FACTOR (TABLE A)
(2) DISCOUNTED SAVINGS/COST (3A X 3A1)

B. NON RECURRING SAVINGS (+) OR COST (-)

ITEM	SAVINGS(+) COST(-)(1)	YEAR OF OCCUR. (2)	DISCOUNT FACTOR(3)	DISCOUNTED SAVINGS(+)COST(-)(4)
a.	$			$
b.	$			$
c.	$			$
d. TOTAL				$

C. TOTAL NON ENERGY DISCOUNTED SAVINGS (3A2+3Bd4)

4. SIMPLE PAYBACK 1G/(2N3+3A+(3Bd1/ECONOMIC LIFE)):	16.21 YEARS
5. TOTAL NET DISCOUNTED SAVINGS (2N5+3C):	$71,960
6. SAVINGS TO INVESTMENT RATION (SIR) 5/1G:	1.08
7. ADJUSTED INTERNAL RATE OF RETURN (AIRR):	0.39%

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CONSTRUCTION COST ESTIMATE	Date Prepared: 1/27/94	
Activity and Location: Energy Savings Opportunity Survey Fort A. P. Hill, Virginia	Constr. Contact No. DACA 31-89-C-0198	I.D. No.
	Estimated By: EAC, P.C.	Category Code
Project: Caulking and Weatherstripping	Status: Final	Job Order No.

ITEM DESCRIPTION	QUANTITY		PRIME CONTRACTOR				SUBCONTRACTOR				TOTAL COST
			MATERIAL COST		LABOR COST		MATERIAL COST		LABOR COST		
SUMMARY	NUMBER	UNIT	UNIT COST	TOTAL	UNIT COST	TOTAL	UNIT COST	TOTAL	UNIT COST	TOTAL	
DIRECT COSTS				7,195		32,973					
							10.0%				
SUBTOTAL (DIRECT COSTS)				7,195		32,973					
Material Tax & Labor Taxes			5.0%	360	21.0%	6,924	5.0%		21.0%		
Overhead			15.0%	1,079	15.0%	4,946	15.0%		15.0%		
SUBTOTAL				8,634		44,843					
Profit			12.0%	1,036	12.0%	5,381	12.0%		12.0%		
SUBTOTAL				9,670		50,224					
Prime Overhead on Sub							5.0%		5.0%		
SUBTOTAL											
Prime Profit on Sub							5.0%		5.0%		
TOTAL COST				9,670		50,224					59,895

CONSTRUCTION COST ESTIMATE	Date Prepared: 1/27/94	
Activity and Location: Energy Savings Opportunity Survey Fort A. P. Hill, Virginia	Constr. Contact No. DACA 31-89-C-0198	I.D. No.
	Estimated By: EAC, P.C.	Category Code
Project: Caulking and Weatherstripping	Status: Final	Job Order No.

ITEM DESCRIPTION	QUANTITY		PRIME CONTRACTOR				SUBCONTRACTOR				
			MATERIAL COST		LABOR COST		MATERIAL COST		LABOR COST		
WEATHERSTRIPPING	NUMBER	UNIT	UNIT COST	TOTAL	UNIT COST	TOTAL	UNIT COST	TOTAL	UNIT COST	TOTAL	TOTAL COST
GROUP A-1	35,469	SF	0.027	958	0.042	1,490					2,447
GROUP A-1 (WINTERIZED)											
GROUP B-1	58,757	SF	0.050	2,938	0.098	5,758					8,696
GROUP B-1 (WINTERIZED)											
GROUP B-2	38,967	SF	0.021	818	0.032	1,247					2,065
GROUP C-1											
GROUP C-1 (WINTERIZED)											
GROUP C-2											
GROUP D-1	16,666	SF	0.031	517	0.046	767					1,283
GROUP D-1 (WINTERIZED)											
GROUP D-2	18,176	SF	0.028	509	0.041	745					1,254
GROUP E-1	9,484	SF	0.055	522	0.083	787					1,309
GROUP E-1 (WINTERIZED)											
SUBTOTAL - WEATHERSTRIPPING				6,261		10,794					17,055
CAULKING											
GROUP A-1	111,771	SF	0.003	335	0.070	7,824					8,159
GROUP A-1 (WINTERIZED)											
GROUP B-1	67,914	SF	0.005	340	0.107	7,267					7,606
GROUP B-1 (WINTERIZED)											
GROUP B-2	38,967	SF	0.004	156	0.108	4,208					4,364
GROUP C-1	27,250	SF	0.001	27	0.033	899					927
GROUP C-1 (WINTERIZED)											
GROUP C-2	3,315	SF	0.004	13	0.097	322					335
GROUP D-1	25,722	SF	0.001	26	0.030	772					797
GROUP D-1 (WINTERIZED)											
GROUP D-2	18,176	SF	0.001	18	0.029	527					545
GROUP E-1	9,484	SF	0.002	19	0.038	360					379
SUBTOTAL - CAULKING				934		22,179					$23,113
SUBTOTAL- (CAULKING + WEATHERSTRIPPING)				$7,195		$32,973					$40,168

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Caulking and Weatherstripping- All buildings listed below require caulking and weatherstripping unless noted otherwise.

Buildings on Previous Report

101	214*	344	1226*
102	215*	345	1227
103	216	346	1231
104	217*	347	1262
105	219*	348	1282*
106A	220*	349	1291*
113	250	350	1301*
115	251	351	1401*
116	253	352	1501*
117	254	353	1525
118	258*	354	1526
119	303	355	1527
120	304*	356	1528
124	305	357	1529
125	306	358	1532
126*	308	359	1533
127*	309	360	1601*
128*	310	361	1622
129*	311	362	2001
130	312*	363	9071
131	313*	364	109*
132	321	501*	320
133	322	705*	820
134	323	712*	821
135*	324	713*	
136*	325	715*	
137	326	803*	
139*	327	808*	
140*	328	811*	
143*	329	812	
144*	330	813	
145*	331	814	
146	332	815	
148*	333	816	
149*	334	817	
151*	335	818	
158*	336	1206	
163	337	1213*	
201*	338	1214*	
205*	339	1220	
207*	340	1221	
208	341	1222*	
209*	342	1224*	
211*	343	1225*	

* Indicates that these buildings do not require weatherstripping around doors.

Engineering
Applications
Consultants

EAC STANDARD FORM
JULY 1985

ENGINEERING ANALYSIS

Sheet 1 of 1

By: JS

Project: ECO FOR AP HILL   Date: 1/8/92

Contract No.: DACA 31-89-C-0198   EAC Project No.: 92008

WEATHERSTRIPPING AROUND WOOD & METAL DOORS

MAT.	LAB.	TOTAL
$ 1.62/LF	$ 2.44/LF	$4.06/LF

CAULKING AROUND WINDOWS, DOORS, etc.

MAT	LAB	TOTAL
$ .03/LF	$ .75/LF	$ .78/LF

BUILDING GROUP ENERGY SAVINGS

CAULKING AND WEATHERSTRIPPING

SUB GROUP	STUDY BUILDING	APPLIED GROUP (SQ.-FT.)	AVERAGE SUB - GROUP SAVINGS BTU/FT^2 - YR.			TOTAL SUB - GROUP SAVINGS MBTU/YR.		
			ELECTRIC	FUEL	TOTAL	ELECTRIC	FUEL	TOTAL
A-1	101,126,214	111771	17	1884	1901	1.9	210.6	212.
B-1	311	67914	0	2095	2095	0	142.3	142.
B-2	1528	38967	0	1692	1692	0	65.9	65.
C-1	313	27250	38	1472	1510	1.0	40.1	41.
C-2	313	3315	38	1472	1510	0.1	4.9	5.
D-1	101,126,214	25722	17	1884	1901	0.4	48.5	48.
D-2	820	18176	502	6833	7335	9.1	124.2	133.
E-1	821	9484	270	3444	3714	2.6	32.6	35.
TOTAL ENERGY SAVINGS BASED ON BLAST COMPUTER MODELS						15.1	669.1	684.

BUILDING GROUP ENERGY USAGE

CAULKING AND WEATHERSTRIPPING ONLY

SUB GROUP	STUDY BUILDING	AVERAGE SUB - GROUP BASIC BTU/FT² - YR.			AVERAGE SUB - GROUP WITH OPTION BTU/FT² - YR.		
		ELECTRIC	FUEL	TOTAL	ELECTRIC	FUEL	TOTAL
A-1	101,126,214	57948	114309	172257	57931	112425	170356
B-1	311	22298	90330	112658	22298	88235	110533
B-2	1528	62964	123417	186381	62964	121725	184689
C-1	313	70902	89282	160184	70864	87810	158674
C-2	SEE C-1						
D-1	SEE A-1						
D-2	820	142940	468524	611464	142438	461691	604129
E-1	821	412543	245961	658504	412273	242517	654790

EXA019-0582/0103

STORM WINDOWS: ENERGY SAVINGS AND ECONOMIC CALCULATIONS

LIFE CYCLE COST ANALYSIS SUMMARY
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)

LOCATION: Fort A.P. Hill, Virginia REGION: 3 PROJECT NO.: DACA 31-89-C-0198
PROJECT TITLE: Fort A.P. Hill- Energy Engineering Analysis Program FISCAL YEAR: 1994
DISCRETE PORTION NAME: Storm Windows
ANALYSIS DATE: January 1994 ECONOMIC LIFE (YRS) 20 PREPARER: JJS

1. INVESTMENT COSTS:

A. CONSTRUCTION COST	$	85,471	
B. SIOH	$	4,701	
C. DESIGN COST	$	5,128	
D. TOTAL COST (1A+1B+1C)	$	95,300	
E. SALVAGE VALUE OF EXISTING EQUIPMENT			
F. PUBLIC UTILITY COMPANY REBATE			
G. TOTAL INVESTMENT (1D-1E-1F)			$95,300

2. ENERGY SAVINGS (+)/COST(-):

DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS- Oct 1992

ENERGY SOURCE	COST $/MBTU(1)	SAVING(S) MBTU/YR(2)		ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)		DISCOUNTED SAVINGS(5)
A. ELEC	$20.67	39.0	$	806	14.65	$	11,810
B. DIST	$5.69	934.1	$	5,315	17.70	$	94,076
C. RESID			$			$	
D. NG			$			$	
E. LPG	$7.76		$			$	
F. COAL			$			$	
G. SOLAR			$			$	
H. GEOTH			$			$	
I. BIOMA			$			$	
J. REFUS			$			$	
K. WIND			$			$	
L. OTHER			$			$	
M. DEMAND SAVINGS			$			$	
N. TOTAL		973	$	6,121		$	105,886

3. NON ENERGY SAVINGS (+) OR COST (-):

A. ANNUAL RECURRING (+/-)
(1) DISCOUNT FACTOR (TABLE A)
(2) DISCOUNTED SAVINGS/COST (3A X 3A1)

B. NON RECURRING SAVINGS (+) OR COST (-)

ITEM		SAVINGS(+) COST(-)(1)	YEAR OF OCCUR. (2)	DISCOUNT FACTOR(3)		DISCOUNTED SAV-INGS(+)COST(-)(4)
a.	$				$	
b.	$				$	
c.	$				$	
d. TOTAL					$	

C. TOTAL NON ENERGY DISCOUNTED SAVINGS (3A2+3Bd4)

4. SIMPLE PAYBACK 1G/(2N3+3A+(3Bd1/ECONOMIC LIFE)):	15.57 YEARS
5. TOTAL NET DISCOUNTED SAVINGS (2N5+3C):	$105,886
6. SAVINGS TO INVESTMENT RATION (SIR) 5/1G:	1.11
7. ADJUSTED INTERNAL RATE OF RETURN (AIRR):	0.55%

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CONSTRUCTION COST ESTIMATE	Date Prepared: 1/27/94	
Activity and Location: Energy Savings Opportunity Survey Fort A. P. Hill, Virginia	Constr. Contact No. DACA 31-89-C-0198	I.D. No.
	Estimated By: EAC, P.C.	Category Code
Project: Storm Window Installation	Status: Final	Job Order No.

ITEM DESCRIPTION	QUANTITY		PRIME CONTRACTOR				SUBCONTRACTOR				TOTAL COST
			MATERIAL COST		LABOR COST		MATERIAL COST		LABOR COST		
SUMMARY	NUMBER	UNIT	UNIT COST	TOTAL	UNIT COST	TOTAL	UNIT COST	TOTAL	UNIT COST	TOTAL	
Subtotal				52,358		9,914					
DIRECT COSTS				52,358		9,914					
SUBTOTAL (DIRECT COSTS)				52,358		9,914					
Material Tax & Labor Taxes			5.0%	2,618	21.0%	2,082	5.0%		21.0%		
Overhead			15.0%	7,854	15.0%	1,487	15.0%		15.0%		
SUBTOTAL				62,830		13,484					
Profit			12.0%	7,540	12.0%	1,618	12.0%		12.0%		
SUBTOTAL				70,369		15,102					
Prime Overhead on Sub							5.0%		5.0%		
SUBTOTAL											
Prime Profit on Sub							5.0%		5.0%		
TOTAL COST				70,369		15,102					$85,471

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CONSTRUCTION COST ESTIMATE	Date Prepared: 1/27/94	
Activity and Location: Energy Savings Opportunity Survey Fort A. P. Hill, Virginia	Constr. Contact No. DACA 31-89-C-0198	I.D. No.
	Estimated By: EAC, P.C.	Category Code
Project: Storm Window Installation	Status: Final	Job Order No.

ITEM DESCRIPTION	QUANTITY		PRIME CONTRACTOR				SUBCONTRACTOR				TOTAL COST
			MATERIAL COST		LABOR COST		MATERIAL COST		LABOR COST		
	NUMBER	UNIT	UNIT COST	TOTAL	UNIT COST	TOTAL	UNIT COST	TOTAL	UNIT COST	TOTAL	
GROUP A-1	29,010	SF	0.259	7,514	0.049	1,424					8,938
GROUP A-1 (WINTERIZED)											
GROUP B-1	40,674	SF	0.439	17,856	0.083	3,384					21,240
GROUP B-1 (WINTERIZED)											
GROUP B-2	38,967	SF	0.456	17,769	0.086	3,351					21,120
GROUP C-1	21,523	SF	0.139	2,992	0.026	560					3,551
GROUP C-1 (WINTERIZED)											
GROUP C-2	2,058	SF	0.409	842	0.077	158					1,000
GROUP D-1	13,166	SF	0.122	1,606	0.024	316					1,922
GROUP D-1 (WINTERIZED)											
GROUP D-2	18,176	SF	0.125	2,272	0.024	436					2,708
GROUP E-1	9,484	SF	0.159	1,508	0.030	285					1,792
GROUP E-1 (WINTERIZED)											
SUB - TOTAL				$52,358		$9,914					$62,272

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Engineering
Applications
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EAC STANDARD FORM
JULY 1985

ENGINEERING ANALYSIS

Sheet 1 of 1

By: JS

Project: ESOS-FORT AP HILL Date: 1/8/92

Contract No.: DACA 31-8? - C-0199 EAC Project No.: 9200?

STORM WINDOW INSTALLATION

LAB	MAT	TOTAL
$.64/SF	$3.38/SF	$4.02/SF

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MMM GROUP
A PROFESSIONAL CORPORATION
ARCHITECTS•ENGINEERS•PLANNERS

DESIGN ANALYSIS

☐ BUDGET
☐ PRELIMINARY
☐ FINAL
☐ OTHER

PROJECT NAME: EEAP - A P HILL	PROJECT PART: STORM WINDOWS	SPEC. DIVISION:
DEPARTMENT: MECHANICAL	COMPUTED BY: CTW DATE: 9/23/82	JOB NO: 4417.02
SHEET NO: OF:	CHECKED BY: DATE:	SHEET NO: OF:

STORM WINDOWS
INVOLVED BUILDINGS:

102	325	347	814
119	326	348	815
136	327	349	816
137	328	350	817
151	329	351	818
163	330	352	820
250	331	353	821
251	332	354	1206
253	333	355	1214
254	334	356	1221
305	335	357	1226
306	336	358	1231
308	337	359	1262
309	338	360	1291
310	339	361	1525
311	340	362	1526
313	341	363	1527
320	342	364	1528
321	343	808	1529
322	344	811	1532
323	345	812	1533
324	346	813	1622
			2001
			9071

81/0108

BUILDING GROUP ENERGY SAVINGS

STORM WINDOWS

SUB GROUP	STUDY BUILDING	APPLIED GROUP (SQ.-FT.)	AVERAGE SUB - GROUP SAVINGS BTU/FT^2 - YR.			TOTAL SUB - GROUP SAVINGS MBTU/FT^2		
			ELECTRIC	FUEL	TOTAL	ELECTRIC	FUEL	TOT
A-1	126,214	29010	90.	3668	3758	2.6	106.4	10
B-1	311	40674	- 30	2156	2126	-1.2	87.7	8
B-2	1528	38967	26	7273	7299	1.0	283.4	28
C-1	313	21523	115	2255	2370	2.5	48.5	5
C-2	313	2058	115	2255	2370	0.2	4.7	
D-1	820	13166	987	11524	12111	13.0	151.7	16
D-2	820	18176	987	11524	12111	17.9	209.5	22
E-1	821	9484	312	4450	4762	3.0	42.2	4
					TOTAL ENERGY SAVINGS BASED ON BLAST COMPUTER MODELS	39.0	934.1	9

BUILDING GROUP ENERGY USAGE

STORM WINDOWS ONLY

SUB GROUP	STUDY BUILDING	AVERAGE SUB - GROUP BASIC BTU/FT² - YR.			AVERAGE SUB - GROUP WITH OPTION BTU/FT² - YR.		
		ELECTRIC	FUEL	TOTAL	ELECTRIC	FUEL	TOTAL
A-1	126,214	52337	115411	167748	52247	111743	163990
B-1	311	22298	90330	112658	22328	88174	110502
B-2	1528	62964	123417	186381	62938	116144	179082
C-1	313	70902	89282	160184	70787	87027	157814
C-2	SEE C-1						
D-1	SEE D-2						
D-2	820	142940	468524	611464	141953	457400	599352
E-1	821	412543	245961	658504	412231	241511	653742

EEA018-0582/0103

OVERHEAD DOOR REPLACEMENT: ENERGY SAVINGS AND ECONOMIC CALCULATIONS

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LIFE CYCLE COST ANALYSIS SUMMARY
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)

LOCATION: Fort A.P. Hill, Virginia REGION: 3 PROJECT NO.: DACA 31-89-C-0198
PROJECT TITLE: Fort A.P. Hill- Energy Engineering Analysis Program FISCAL YEAR: 1994
DISCRETE PORTION NAME: Overhead Door Replacement
ANALYSIS DATE: January 1994 ECONOMIC LIFE (YRS) 20 PREPARER: JJS

1. INVESTMENT COSTS:

A. CONSTRUCTION COST	$	114,023	
B. SIOH	$	6,271	
C. DESIGN COST	$	6,841	
D. TOTAL COST (1A+1B+1C)	$	127,136	
E. SALVAGE VALUE OF EXISTING EQUIPMENT			
F. PUBLIC UTILITY COMPANY REBATE			
G. TOTAL INVESTMENT (1D-1E-1F)			$127,136

2. ENERGY SAVINGS (+)/COST(-):

DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS- Oct 1992

ENERGY SOURCE	COST $/MBTU(1)	SAVING(S) MBTU/YR(2)	ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELEC	$20.67	4.2	$ 87	14.65	$ 1,272
B. DIST	$5.69	248.9	$ 1,416	17.70	$ 25,067
C. RESID			$		$
D. NG			$		$
E. LPG	$7.76		$		$
F. COAL			$		$
G. SOLAR			$		$
H. GEOTH			$		$
I. BIOMA			$		$
J. REFUS			$		$
K. WIND			$		$
L. OTHER			$		$
M. DEMAND SAVINGS			$		$
N. TOTAL		253	$ 1,503		$ 26,339

3. NON ENERGY SAVINGS (+) OR COST (-):

A. ANNUAL RECURRING (+/-)
(1) DISCOUNT FACTOR (TABLE A)
(2) DISCOUNTED SAVINGS/COST (3A X 3A1)

B. NON RECURRING SAVINGS (+) OR COST (-)

ITEM	SAVINGS(+) COST(-)(1)	YEAR OF OCCUR. (2)	DISCOUNT FACTOR(3)	DISCOUNTED SAVINGS(+)COST(-)(4)
a.	$			$
b.	$			$
c.	$			$
d. TOTAL				$

C. TOTAL NON ENERGY DISCOUNTED SAVINGS (3A2+3Bd4)

4. SIMPLE PAYBACK 1G/(2N3+3A+(3Bd1/ECONOMIC LIFE)):	84.58 YEARS
5. TOTAL NET DISCOUNTED SAVINGS (2N5+3C):	$26,339
6. SAVINGS TO INVESTMENT RATION (SIR) 5/1G:	0.21
7. ADJUSTED INTERNAL RATE OF RETURN (AIRR):	-7.87%

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LIFE CYCLE COST ANALYSIS SUMMARY
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)

LOCATION: Fort A.P. Hill, Virginia   REGION: 3   PROJECT NO.: DACA 31-89-C-0198
PROJECT TITLE: Fort A.P. Hill- Energy Engineering Analysis Program   FISCAL YEAR: 1994
DISCRETE PORTION NAME: Overhead Door Replacement
ANALYSIS DATE: January 1994   ECONOMIC LIFE (YRS) 20   PREPARER: JJS

1. INVESTMENT COSTS:

A. CONSTRUCTION COST	$	114,023	
B. SIOH	$	6,271	
C. DESIGN COST	$	6,841	
D. TOTAL COST (1A+1B+1C)	$	127,136	
E. SALVAGE VALUE OF EXISTING EQUIPMENT			
F. PUBLIC UTILITY COMPANY REBATE			
G. TOTAL INVESTMENT (1D-1E-1F)			$127,136

2. ENERGY SAVINGS (+)/COST(-):

DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS- Oct 1992

ENERGY SOURCE	COST $/MBTU(1)	SAVING(S) MBTU/YR(2)		ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)		DISCOUNTED SAVINGS(5)
A. ELEC	$20.67	4.2	$	87	14.65	$	1,272
B. DIST	$5.69	1,416.0	$	8,057	17.70	$	142,610
C. RESID			$			$	
D. NG			$			$	
E. LPG	$7.76		$			$	
F. COAL			$			$	
G. SOLAR			$			$	
H. GEOTH			$			$	
I. BIOMA			$			$	
J. REFUS			$			$	
K. WIND			$			$	
L. OTHER			$			$	
M. DEMAND SAVINGS			$			$	
N. TOTAL		1,420	$	8,144		$	143,881

3. NON ENERGY SAVINGS (+) OR COST (-):

A. ANNUAL RECURRING (+/-)
(1) DISCOUNT FACTOR (TABLE A)
(2) DISCOUNTED SAVINGS/COST (3A X 3A1)

B. NON RECURRING SAVINGS (+) OR COST (-)

ITEM		SAVINGS(+) COST(-)(1)	YEAR OF OCCUR. (2)	DISCOUNT FACTOR(3)		DISCOUNTED SAVINGS(+)COST(-)(4)
a.	$				$	
b.	$				$	
c.	$				$	
d. TOTAL					$	

C. TOTAL NON ENERGY DISCOUNTED SAVINGS (3A2+3Bd4)

4. SIMPLE PAYBACK 1G/(2N3+3A+(3Bd1/ECONOMIC LIFE)):	15.61 YEARS
5. TOTAL NET DISCOUNTED SAVINGS (2N5+3C):	$143,881
6. SAVINGS TO INVESTMENT RATION (SIR) 5/1G:	1.13
7. ADJUSTED INTERNAL RATE OF RETURN (AIRR):	0.65%

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CONSTRUCTION COST ESTIMATE	Date Prepared: 1/27/94	
Activity and Location: Energy Savings Opportunity Survey Fort A. P. Hill, Virginia	Constr. Contact No. DACA 31-89-C-0198	I.D. No.
	Estimated By: EAC, P.C.	Category Code
Project: Overhead Door Replacement	Status: Final	Job Order No.

ITEM DESCRIPTION	QUANTITY		PRIME CONTRACTOR				SUBCONTRACTOR				TOTAL COST
			MATERIAL COST		LABOR COST		MATERIAL COST		LABOR COST		
SUMMARY	NUMBER	UNIT	UNIT COST	TOTAL	UNIT COST	TOTAL	UNIT COST	TOTAL	UNIT COST	TOTAL	
Subtotal				53,955		27,250					
DIRECT COSTS				53,955		27,250					
SUBTOTAL (DIRECT COSTS)				53,955		27,250					
Material Tax & Labor Taxes			5.0%	2,698	21.0%	5,723	5.0%		21.0%		
Overhead			15.0%	8,093	15.0%	4,088	15.0%		15.0%		
SUBTOTAL				64,746		37,060					
Profit			12.0%	7,770	12.0%	4,447	12.0%		12.0%		
SUBTOTAL				72,516		41,507					
Prime Overhead on Sub							5.0%		5.0%		
SUBTOTAL											
Prime Profit on Sub							5.0%		5.0%		
TOTAL COST				72,516		41,507					$114,023

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CONSTRUCTION COST ESTIMATE	Date Prepared: 1/27/94	Reference: MMM Design 1982
Activity and Location: Energy Savings Opportunity Survey Fort A. P. Hill, Virginia	Constr. Contact No. DACA 31-89-C-0198	I.D. No.
	Estimated By: EAC, P.C.	Category Code
Project: Overhead Door Replacement	Status: Final	Job Order No.

ITEM DESCRIPTION	QUANTITY		PRIME CONTRACTOR				SUBCONTRACTOR				TOTAL COST
			MATERIAL COST		LABOR COST		MATERIAL COST		LABOR COST		
	NUMBER	UNIT	UNIT COST	TOTAL	UNIT COST	TOTAL	UNIT COST	TOTAL	UNIT COST	TOTAL	
Group A-1											
Group A-1 (Winterized)											
Group B-1											
Group B-1 (Windterized)											
Group B-2											
Group C-1	27,250	SF	1.98	53,955	1.00	27,250					81,205
Group C-1 (Winterized)											
Group C-2											
Group D-1											
Group D-1 (Winterized)											
Group D-2											
Group E-1											
Group E-1 (Winterized)											
SUBTOTAL				$53,955		$27,250					$81,205

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DESIGN ANALYSIS

XXXX BUDGET
☐ PRELIMINARY
☐ FINAL
☐ OTHER

PROJECT NAME: FORT A.P. HILL E.E.A.	PROJECT PART: OVERHEAD DOOR REPLCMT.	SPEC. DIVISION: COST ESTIMATE
DEPARTMENT: Architectural	COMPUTED BY: RW DATE: 5-5-82	JOB NO: 4417.02
SHEET NO: OF:	CHECKED BY: DATE:	SHEET NO: OF:

A	B	C	D	E=D÷C	F	G=ExF
SUB GROUP	BUILDING NUMBER	FLOOR AREA - S.F.	PROJECT AREA - FT^2	RATIO	UNIT COST	COST PER FT OF FLOOR AREA
A-1	101	5080			L. 12.37 M. 6.25	
A-1	126	2490				
B-1	311	3247				
B-2	1528	7563				
C-1	313	5171	831	.160	L 12.37 M. 6.25	1.98 1.00 2.98
C-2	1290	9306				
D-1	179	6275				
D-2	820	6176				
E-1	821	5984				

FM-068, /0109

-120

BUILDING GRC P ENERGY SAVINGS

FORT A.P. HILL — OVERHEAD DOOR REPLACEMENT

BUILDING GROUP	SAMPLE BUILDING	TOTAL GROUP SQ.-FT.	SAMPLE BUILDING GROUP AVERAGE BTU/FT^2-YR.			TOTAL BUILDING GROUP AVERAGE BTU/FT^2-YR. X 10^6		
			ELECTRIC	FUEL	TOTAL	ELECTRIC	FUEL	TOTAL
A1	101, 214 126	0	0	0	0			
A1 WINT	-	0	0	0	0			
B1	311 179.B	0	0	0	0			
	-	0	0	0	0			
B2	1528	0	0	0	0			
C1	313	27250	153	9133	9286	4.2	248.9	253.0
*C2	1290		0	0	0			
D1	179.D1	0	0	0	0			
	-	0	0	0	0			
	820	0	0	0	0			
	821	0	0	0	0			
BASE	TOTALS -					4.2	248.9	253.0

FEFAKI-0182/0108

TIMER SWITCHES: ENERGY SAVINGS AND ECONOMIC CALCULATIONS

LIFE CYCLE COST ANALYSIS SUMMARY

ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)

LOCATION: Fort A.P. Hill, Virginia   REGION: 3   PROJECT NO.: DACA 31-89-C-0198

PROJECT TITLE: Fort A.P. Hill- Energy Engineering Analysis Program   FISCAL YEAR: 1994

DISCRETE PORTION NAME: Timer Switches

ANALYSIS DATE: January 1994   ECONOMIC LIFE (YRS) 15   PREPARER: JJS

1. INVESTMENT COSTS:

A. CONSTRUCTION COST	$	28,017	
B. SIOH	$	1,541	
C. DESIGN COST	$	1,681	
D. TOTAL COST (1A+1B+1C)	$	31,239	
E. SALVAGE VALUE OF EXISTING EQUIPMENT			
F. PUBLIC UTILITY COMPANY REBATE			
G. TOTAL INVESTMENT (1D-1E-1F)			$31,239

2. ENERGY SAVINGS (+)/COST(-):

DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS- Oct 1992

ENERGY SOURCE	COST $/MBTU(1)	SAVING(S) MBTU/YR(2)		ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)		DISCOUNTED SAVINGS(5)
A. ELEC	$20.67	109.0	$	2,253	11.77	$	26,518
B. DIST	$5.69		$			$	
C. RESID			$			$	
D. NG			$			$	
E. LPG	$7.76		$			$	
F. COAL			$			$	
G. SOLAR			$			$	
H. GEOTH			$			$	
I. BIOMA			$			$	
J. REFUS			$			$	
K. WIND			$			$	
L. OTHER			$			$	
M. DEMAND SAVINGS			$			$	
N. TOTAL		109	$	2,253		$	26,518

3. NON ENERGY SAVINGS (+) OR COST (-):

A. ANNUAL RECURRING (+/-)

(1) DISCOUNT FACTOR (TABLE A)

(2) DISCOUNTED SAVINGS/COST (3A X 3A1)

B. NON RECURRING SAVINGS (+) OR COST (-)

ITEM		SAVINGS(+) COST(-)(1)	YEAR OF OCCUR. (2)	DISCOUNT FACTOR(3)		DISCOUNTED SAV-INGS(+)COST(-)(4)
a.	$				$	
b.	$				$	
c.	$				$	
d. TOTAL					$	

C. TOTAL NON ENERGY DISCOUNTED SAVINGS (3A2+3Bd4)

4. SIMPLE PAYBACK 1G/(2N3+3A+(3Bd1/ECONOMIC LIFE)):	13.87 YEARS
5. TOTAL NET DISCOUNTED SAVINGS (2N5+3C):	$26,518
6. SAVINGS TO INVESTMENT RATION (SIR) 5/1G:	0.85
7. ADJUSTED INTERNAL RATE OF RETURN (AIRR):	-1.13%

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CONSTRUCTION COST ESTIMATE	Date Prepared: 1/27/94	
Activity and Location: Energy Savings Opportunity Survey Fort A. P. Hill, Virginia	Constr. Contact No. DACA 31-89-C-0198 Estimated By: EAC, P.C.	I.D. No. Category Code
Project: Storm Window Installation	Status: Final	Job Order No.

ITEM DESCRIPTION	QUANTITY		PRIME CONTRACTOR				SUBCONTRACTOR				TOTAL COST
			MATERIAL COST		LABOR COST		MATERIAL COST		LABOR COST		
SUMMARY	NUMBER	UNIT	UNIT COST	TOTAL	UNIT COST	TOTAL	UNIT COST	TOTAL	UNIT COST	TOTAL	
Subtotal				13,980		6,058					
DIRECT COSTS				13,980		6,058					
SUBTOTAL (DIRECT COSTS)				13,980		6,058					
Material Tax & Labor Taxes			5.0%	699	21.0%	1,272	5.0%		21.0%		
Overhead			15.0%	2,097	15.0%	909	15.0%		15.0%		
SUBTOTAL				16,776		8,239					
Profit			12.0%	2,013	12.0%	989	12.0%		12.0%		
SUBTOTAL				18,789		9,228					
Prime Overhead on Sub							5.0%		5.0%		
SUBTOTAL											
Prime Profit on Sub							5.0%		5.0%		
TOTAL COST				18,789		9,228					28,017

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CONSTRUCTION COST ESTIMATE	Date Prepared: 1/27/94	Reference: MMM Design/ Manufacturer's Pricing
Activity and Location: Energy Savings Opportunity Survey Fort A. P. Hill, Virginia	Constr. Contact No. DACA 31-89-C-0198	I.D. No.
	Estimated By: EAC, P.C.	Category Code
Project: Timer Switches	Status: Final	Job Order No.

ITEM DESCRIPTION	QUANTITY		PRIME CONTRACTOR				SUBCONTRACTOR				TOTAL COST
			MATERIAL COST		LABOR COST		MATERIAL COST		LABOR COST		
	NUMBER	UNIT	UNIT COST	TOTAL	UNIT COST	TOTAL	UNIT COST	TOTAL	UNIT COST	TOTAL	
Timer Switches (Occupancy Sensors)	233	EA	60	13,980	26.00	6,058					20,038
SUB - TOTAL				$13,980		$6,058					$20,038

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January 1991

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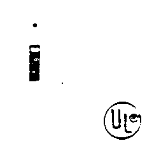
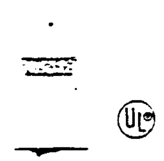
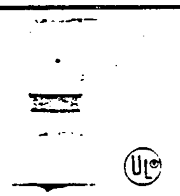
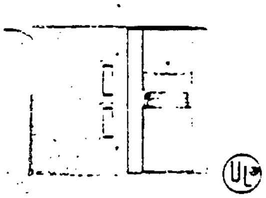
PASSIVE INFRARED AUTOMATIC 2 WIRE WALL LIGHT SWITCHES

Model	Description	Unit Price 1-23	24-95	96-249	250 & Up
 Model SOM-500-A	***Switchomat***™ Manual lights off switch with built-in safety neon night light. Occupancy sensor, up to 800 sq. ft. coverage. 120/277 Volt, 1000/1800 Watt switching capacity fluorescent or incandescent. Immediate activation when entering room.	$60.00	$56.00	$52.00	$48.00
 Model SOM-1000-A	***Switchomat***™ Occupancy sensor, up to 1000 sq. ft. coverage. 120/277 Volt, 1000/1800 Watt switching capacity fluorescent or incandescent, 180° coverage. Immediate activation when entering room.	64.00	60.00	56.00	52.00
 Model SOM-1000-A-2	***Switchomat***™ 2 switches, 2 circuits. Occupancy sensor, up to 1000 sq. ft. coverage. 120/277 Volt, 1000/1800 Watt switching capacity on each circuit (2 wires) 180° coverage. Immediate activation when entering room. *Heavy duty model with larger switching capacity available upon request.*	70.00	66.00	62.00	58.00
 Model SOM-1000-B	***Switchomat***™ Occupancy sensor, up to 1000 sq.ft. coverage. Single circuit heavy load capacity. Minimum 900 Watt to Maximum 2400 Watt at 120V ballast rating. Minimum 1800 Watt to Maximum 4500 Watt at 277V ballast rating, 180° coverage. Immediate activation when entering room.	71.00	67.00	63.00	59.00
	Switchomat™ MODEL SOM-1200-2-HD, SPECIFICALLY DESIGNED FOR CLASSROOMS				
 Model SOM-1200-2-HD	2 switches, 2 circuits, occupancy sensor, up to 4000 sq. ft. coverage, 120/277V, 2000/4000 Watt switching capacity on each circuit (2 wires) 180° coverage. Immediate activation when entering. Can be mounted in either a double or triple gang wall box or plaster ring.	96.00	92.00	88.00	84.00

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Why use UEC's occupancy sensing automatic light switching?

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Watts Per Room	Total KWH Cost	10 Year Lighting Expense Using Manual Light Switching	10 Year Savings with Automatic Light Switching		
			30% savings	40% savings	50% savings
400	7¢	$ 980	$ 294	$ 392	$ 490
	8¢	1120	336	448	560
	10¢	1400	420	560	700
600	7¢	1470	441	588	734
	8¢	1680	504	672	840
	10¢	2100	630	840	1050
1000	7¢	2450	735	980	1225
	8¢	2800	840	1120	1400
	10¢	3500	1050	1400	1750
2000	7¢	4900	1470	1960	2450
	8¢	5600	1680	2240	2800
	10¢	7000	2100	2800	3500

Notes:
Lighting expense based on average 3500 hour yearly use.
Calculations do not include provisions for yearly rate increases, holidays or air conditioning savings.

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OUTSIDE TX: 1-800-833-8937
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Engineering
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EAC STANDARD FORM
JULY 1985

ENGINEERING ANALYSIS

Sheet 1 of 1

By: [illegible]

Project: [illegible] FORT AP [illegible]   Date: 1/8/92

Contract No.: [illegible] 89-C-0197   EAC Project No.: 92008

FOR NEW ECIP CRITERIA THE CONVERSION FROM KWH to BTU'S = $3,413 \frac{BTU}{KWH}$

TOTAL KWH'S SAVED = $32{,}076 \text{ KWH} \times \frac{3413 \text{ BTU}}{1 \text{ KWH}} \times \frac{1 \text{ MBTU}}{10^6 \text{ BTU}}$

= 109 MBTU

BUILDING GROUP ENERGY SAVINGS

FORT HILL — TIMER SWITCHES

BUILDING GROUP	NON WINTERIZED. BLDG's				WINTERIZED BLDG'S				TOTAL SAVING	
	NUMBER OF BLDG's	TIMER SW / BLDG	KWH/Y / BLDG (SAVINGS)	SAVINGS (KWH)	NUMBER OF BLDGS	TIMER S. / BLDG	KWH/Y / BLDG (SAVINGS)	SAVINGS (KWH)	KWH	MB
A-1	45	2	200	9000	6	2	200	1200	10200	118.
A-2	—	—	—	—	—	—	—	—	—	—
B-1	—	—	—	—	—	—	—	—	—	—
B-2	6	3	250	1500	—	—	—	—	1500	17.
B-3	—	—	—	—	38	1	156	5928	5928	68.7
C-1	8	1	94	752	2	1	94	188	940	10.9
C-2	21	2	520	10920	—	—	—	—	10920	126.6
C-3	—	—	—	—	—	—	—	—	—	—
D-1	8	2	187	1496	—	—	—	—	1496	17.3
D-2	2	1	156	312	—	—	—	—	312	3.6
D-3	2	1	156	312	3	1	156	468	780	9.0
F-1	—	—	—	—	—	—	—	—	—	—
E-2	—	—	—	—	—	—	—	—	—	—
		180				55				372.

TOTAL NUMBER OF TIMER SWITCHES = 233

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DESIGN ANALYSIS

- [x] BUDGET
- [ ] PRELIMINARY
- [ ] FINAL
- [ ] OTHER

PROJECT NAME: EFA - FORT HILL	PROJECT PART: TIMER SWITCHES	SPEC. DIVISION:
DEPARTMENT: ELECTRICAL	COMPUTED BY: CJA DATE: 5-11-82	JOB NO: 4417.02
SHEET NO: OF:	CHECKED BY: DATE:	SHEET NO: OF:

APPLICABLE BUILDINGS

GROUP A-1
~~101~~, 103, 104, ~~105~~, 109, 113, ~~115~~, 116, 124, ~~126~~, 127, 128, ~~129~~, 134, 135, ~~136~~, 137, 139, ~~140~~, 144, 120, ~~145~~, 158, 163, ~~201~~, 214, 217, ~~250~~, 251, 312, ~~815~~, 816, 817, ~~818~~, 1220, 1221, ~~1225~~, 1262, 1527, ~~2001~~, 9071, 1206, ~~1227~~, 1231, 304
~~121~~, 122, 123, ~~224~~, 1201, 1535

GROUP B-2
~~253~~, 1526, 1528, 1529, 1532, 1533

GROUP B-3
1635, 1636, ~~1637~~, 1638, 1639, ~~1640~~, 1642, 1643, ~~1644~~, 1645, 1646, ~~1647~~, 1648, 1649, ~~1651~~, 1652, 1653, ~~1655~~, 1657, 1658, ~~1662~~, 1663, 1666, ~~1667~~, 1668, 1669, ~~1671~~, 1680, 1681, ~~1682~~, 1688, 1689, ~~1691~~, 1692, 1693, 1695, 1696, 1694

GROUP C-1
102, 106A, ~~313~~, 808, 1214, ~~1224~~, 1226, 1282, 142, 708

GROUP C-2
148, 149, ~~151~~, 219, 220, ~~258~~, 501, 705, ~~803~~, 1213, 1222, ~~1290~~, 1219, 1301, ~~1401~~, 1501, 1601, ~~1326~~, 1327, 1545, ~~1546~~

GROUP D-1
143, 179B, ~~216~~, 303, 811, ~~812~~, 813, 814

GROUP D-2
820, 1525

GROUP D-
1204, 175, 1641, 1659, 1690

WATER HEATER CONTROLS: ENERGY SAVINGS AND ECONOMIC CALCULATIONS

LIFE CYCLE COST ANALYSIS SUMMARY

ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)

LOCATION: Fort A.P. Hill, Virginia REGION: 3 PROJECT NO.: DACA 31-89-C-0198

PROJECT TITLE: Fort A.P. Hill- Energy Engineering Analysis Program FISCAL YEAR: 1994

DISCRETE PORTION NAME: Water Heater Controls

ANALYSIS DATE: January 1994 ECONOMIC LIFE (YRS) 10 PREPARER: JJS

1. INVESTMENT COSTS:

A. CONSTRUCTION COST	$	82	
B. SIOH	$	5	
C. DESIGN COST	$	5	
D. TOTAL COST (1A+1B+1C)	$	91	
E. SALVAGE VALUE OF EXISTING EQUIPMENT			
F. PUBLIC UTILITY COMPANY REBATE			
G. TOTAL INVESTMENT (1D-1E-1F)			$91

2. ENERGY SAVINGS (+)/COST(-):

DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS- Oct 1992

ENERGY SOURCE	COST $/MBTU(1)	SAVING(S) MBTU/YR(2)	ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELEC	$20.67	0.4	$ 7	14.65	$ 109
B. DIST	$5.69		$		$
C. RESID			$		$
D. NG			$		$
E. LPG	$7.76		$		$
F. COAL			$		$
G. SOLAR			$		$
H. GEOTH			$		$
I. BIOMA			$		$
J. REFUS			$		$
K. WIND			$		$
L. OTHER			$		$
M. DEMAND SAVINGS			$		$
N. TOTAL		0	$ 7		$ 109

3. NON ENERGY SAVINGS (+) OR COST (-):

A. ANNUAL RECURRING (+/-)

(1) DISCOUNT FACTOR (TABLE A)

(2) DISCOUNTED SAVINGS/COST (3A X 3A1)

B. NON RECURRING SAVINGS (+) OR COST (-)

ITEM	SAVINGS(+) COST(-)(1)	YEAR OF OCCUR. (2)	DISCOUNT FACTOR(3)	DISCOUNTED SAV-INGS(+)COST(-)(4)
a.	$			$
b.	$			$
c.	$			$
d. TOTAL				$

C. TOTAL NON ENERGY DISCOUNTED SAVINGS (3A2+3Bd4)

4. SIMPLE PAYBACK 1G/(2N3+3A+(3Bd1/ECONOMIC LIFE)):	12.29 YEARS
5. TOTAL NET DISCOUNTED SAVINGS (2N5+3C):	$109
6. SAVINGS TO INVESTMENT RATION (SIR) 5/1G:	1.19
7. ADJUSTED INTERNAL RATE OF RETURN (AIRR):	1.85%

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CONSTRUCTION COST ESTIMATE	Date Prepared: 1/27/94	
Activity and Location: Energy Savings Opportunity Survey Fort A. P. Hill, Virginia	Constr. Contact No. DACA 31-89-C-0198 Estimated By: EAC, P.C.	I.D. No. Category Code
Project: Water Heater Controls	Status: Final	Job Order No.

ITEM DESCRIPTION	QUANTITY		PRIME CONTRACTOR				SUBCONTRACTOR				TOTAL COST
			MATERIAL COST		LABOR COST		MATERIAL COST		LABOR COST		
SUMMARY	NUMBER	UNIT	UNIT COST	TOTAL	UNIT COST	TOTAL	UNIT COST	TOTAL	UNIT COST	TOTAL	
Subtotal				40		18					
DIRECT COSTS				40		18					
SUBTOTAL (DIRECT COSTS)				40		18					
Material Tax & Labor Taxes			5.0%	2	21.0%	4	5.0%		21.0%		
Overhead			15.0%	6	15.0%	3	15.0%		15.0%		
SUBTOTAL				48		25					
Profit			12.0%	6	12.0%	3	12.0%		12.0%		
SUBTOTAL				54		28					
Prime Overhead on Sub							5.0%		5.0%		
SUBTOTAL											
Prime Profit on Sub							5.0%		5.0%		
TOTAL COST				54		28					82

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CONSTRUCTION COST ESTIMATE	Date Prepared: 1/27/94	Reference: 1992 RS MEANS RESIDENTIAL- Pg 390; item 3702
Activity and Location: Energy Savings Opportunity Survey Fort A. P. Hill, Virginia	Constr. Contact No. DACA 31-89-C-0198	I.D. No.
	Estimated By: EAC, P.C.	Category Code
Project: Water Heater Controls	Status: Final	Job Order No.

ITEM DESCRIPTION	QUANTITY		PRIME CONTRACTOR				SUBCONTRACTOR				TOTAL COST
			MATERIAL COST		LABOR COST		MATERIAL COST		LABOR COST		
	NUMBER	UNIT	UNIT COST	TOTAL	UNIT COST	TOTAL	UNIT COST	TOTAL	UNIT COST	TOTAL	
Water Heater Controls- Timer Switch Per Tank	1	EA	40	40	18.25	18					58
SUB - TOTAL				$40		$18					$58

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DESIGN ANALYSIS
- ☐ BUDGET
- ☐ PRELIMINARY
- ■ FINAL
- ☐ OTHER

SHEET NO: 2 OF: 2
JOB NO: 4770.00
DEPARTMENT: MECH
SHEET NO: OF:
COMPUTED BY: RDC DATE: 6/2/83
CHECKED BY: JAD DATE: 6/2/83

CT NAME: FORT HILL - EEAP
PROJECT PART: WATER HEATER CONTROLS
DIVISION:

III. BTU SAVINGS

BTU SAVED = (BTU USED TO MAINTAIN 120°F - BTU REQ'D TO RETURN 112.1°F WATER TO 120°F)

= 3706.8 - 3416.5

= 290.3 BTU SAVED / HEATER / DAY

BTU SAVED / YR = 290.3 × 365 DAYS

= 105959 BTU / YR = 0.106 MBTU / YR.

IV. BTU SAVINGS FOR ELECTRIC WATER HEATERS

$$0.106 \text{ MBTU} \times \frac{11,600 \text{ BTU/KW}}{3,413 \text{ BTU/KW}} = 0.360 \text{ MBTU/YR.}$$

FRM054-001

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DESIGN ANALYSIS

☐ PRELIMINARY
■ FINAL
☐ OTHER

SHEET NO: 1 OF: 2
JOB NO: 4770.00

PROJECT NAME: ...ORT HILL - EEAP

DEPARTMENT: MECH
SHEET NO: OF:

PROJECT PART: WATER HEATER CONTROLS

COMPUTED BY: BDC DATE: 6/2/83

DIVISION:

CHECKED BY: TAD DATE: 6/2/83

DOMESTIC WATER HEATER CONTROLS

"U" VALUE OF HEATER TANK = 0.22

APPROXIMATE SURFACE AREA OF 52 GAL. TANK = 27 FT^2

ASSUME A 12 HOUR SYSTEM SHUTDOWN OF 120°F TANK:

I. BTU PRESENTLY USED TO MAINTAIN TEMPERATURE

$Q = UA\Delta T \times 12$ HOURS

$= 0.22(27)(120-68) \times 12 = 308.9 \times 12$

$= 3706.8$ BTU

II. TOTAL HEAT LOST DURING 12 HOUR SYSTEM SHUTDOWN

NEW TANK TEMP. = INITIAL TANK TEMP. − BTU LOST / 52 gal (8.39 LB./GAL)

BTU LOST = (INITIAL TANK TEMP − 68) U(A)

CALCULATED HOURLY:

TIME (hours)	TANK TEMP. (°F)	Q LOST/HR. @ TANK TEMP.	Q LOST (BTU)
0	120.0	308.9	306.8
1	119.3	304.6	302.6
2	118.6	300.5	298.5
3	117.9	296.4	294.4
4	117.2	292.3	290.3
5	116.5	288.3	286.3
6	115.9	284.3	282.4
7	115.2	280.5	278.6
8	114.6	276.6	274.7
9	113.9	272.8	271.0
10	113.3	269.1	267.3
11	112.7	265.4	263.6
12	112.1	261.8	

TOTAL HEAT LOST (BTU REQ'D TO RETURN TO 120°) = 3416.5

NORFOLK, VIRGINIA ▪ WASHINGTON, D.C. ▪ ATHENS, GREECE ▪ HOUSTON, TEXAS ▪ FRANKFURT, GERMANY

FRM004.0881/0109

Dura-Power

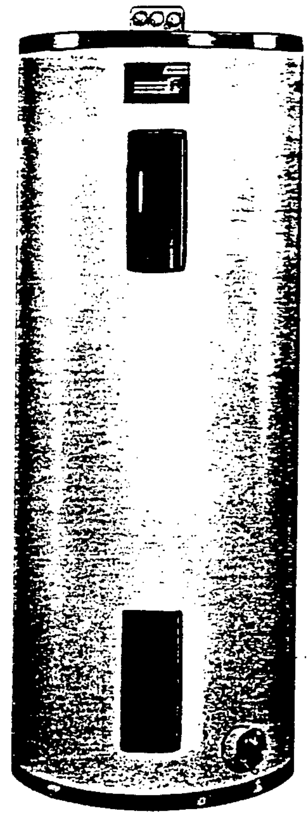
COMMERCIAL ELECTRIC WATER HEATERS

DEN & DEL MODELS

A. O. SMITH

Designed for use as a recovery heater having its own storage tank. Available in upright standard models (DEN) and lowboy models (DEL).

Meets or exceeds the requirements of ASHRAE 90A-1980 Standard for energy efficiencies.



FEATURES

GLASS-LINED TANK - Nine sizes; 30 thru 119 gallon capacity. Tank interior is coated with glass specially developed by A. O. Smith Ceramic Research for water heater use. Tanks rated 150 psi working pressure; tested at 300 psi. Foam insulation provides maximum energy savings by minimizing radiant standby heat loss.

ELEMENTS - Zinc plated copper sheaths for longer life. Medium watt density; means lower surface temperature to minimize scale build-up and more surface to heat water. Element sizes from 3 to 6 KW. Use two elements; maximum input 12 KW (see chart on back).

STANDARD VOLTAGES - 208, 240 and 480V unbalanced three-phase delta. Factory wired for three-phase; easily converted to single-phase at terminal block (except 208V with 6000 watt elements).

TERMINAL BLOCK - Factory installed. Just bring the service to heater and connect to block.

CONTROLS - One temperature control (adjustable through a range of 110°to 170°F) and manual reset high temperature cutoff per element. Factory wired for non-simultaneous operation; easily converted to simultaneous element operation.

OTHER STANDARD FEATURES

• Simplified circuitry, color coded for ease of service • Anode rod for maximum corrosion protection • Cabinet has bonderized undercoat with baked enamel finish • Top inlet and oultet openings • Drain valve.

UL

See page C 029.0 for service wiring and fuse selection.

LIMITED WARRANTY OUTLINE

If the tank should leak any time during the first three years, under the terms of the warranty, A. O. Smith will furnish a replacement heater; installation, labor, handling and local delivery extra. THIS OUTLINE IS NOT A WARRANTY. For complete information, consult the written warranty or A. O. Smith Water Products Company.

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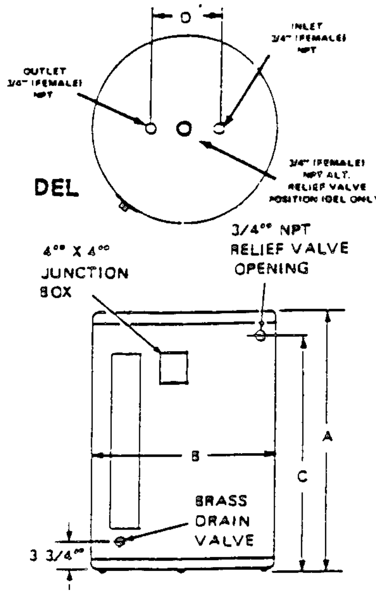


ALL DIMENSIONS IN INCHES

Models	Tank Capacity Gallons	A	B	C	D	Approx. Ship. Wt. (Lbs.)
DEN-30	30	46 3/8	18	-----	8	98
DEL-30	30	30 7/8	21 3/4	24 1/8	8	100
DEN-40	40	45 1/8	20 1/2	-----	8	113
DEL-40	40	32 1/4	23 1/4	25 9/16	8	125
DEN-52	50	54 7/8	20 1/2	-----	8	131
DEL-50	50	32 1/4	25 1/4	25 1/8	8	166
DEN-66	66	60 3/4	21 3/4	-----	8	176
DEN-80	80	59 3/8	24	-----	8	211
DEN-120	119	62 7/16	29 3/8	-----	8	326

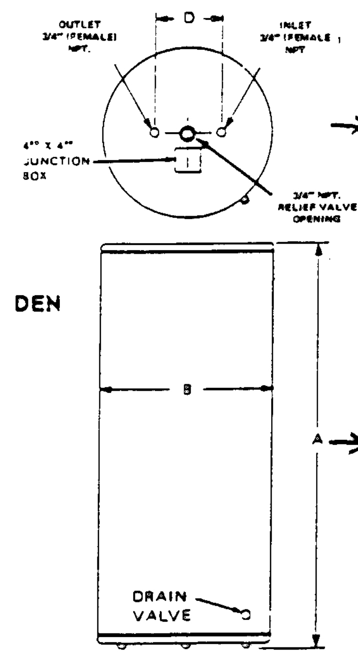
ELECTRIC CHARACTERISTICS AND CAPACITIES

NON-SIMULTANEOUS ELEMENT OPERATION

Element Wattage Upper/Lower	Recovery Capacities GPH @ Temperature Rise Of					Full Load Current in Amperes Connected to Three Phase Power (All Terminals - L_1, L_2, & L_3)		
	40°	60°	80°	100°	120°	208V	240V	480V
3000/3000	31	20	15	12	10	14.4	12.5	6.3
4000/4000	41	27	20	16	14	19.2	16.7	8.3
4500/4500	46	31	23	18	15	21.6	18.8	9.4
5000/5000	51	34	26	20	17	24.0	20.8	10.4
6000/6000	61	41	31	25	20	28.8	25.0	12.5

SIMULTANEOUS ELEMENT OPERATION

Element Wattage Upper/Lower	Recovery Capacities GPH @ Temperature Rise Of					Full Load Current in Amperes Connected to Three Phase Power (Terminal L_2/Terminals L_1 & L_3)		
	40°	60°	80°	100°	120°	208V	240V	480V
3000/3000	41	27	20	16	14	25.0/14.4	21.7/12.5	10.8/6.3
4000/4000	55	36	27	22	18	33.3/19.2	28.9/16.7	14.4/8.3
4500/4500	61	4	31	25	20	37.5/21.6	32.5/18.8	16.2/9.4
5000/5000	68	46	34	27	23	41.6/24.0	36.1/20.8	18.0/10.4
6000/6000	82	55	41	33	27	N/A	43.3/25.0	21.7/12.5



Recovery capacities at 100°F rise equal: for non-simultaneous element operation - 4.1 gal. x KW of one element; for simultaneous element operation - 4.1 gal. x 2/3 KW of both elements. For other rises multiply element KW as previously explained by 410 and divide by temperature rise.

SUGGESTED SPECIFICATIONS

The water heater(s) shall be Dura-Power Model(s) No. ________________ as manufactured by A. O. SMITH or an approved equal. Heater(s) shall be rated at ____________ KW, ____________ volts, ____________ phase, 60 cycle AC, and listed by Underwriters' Laboratories. Tank(s) shall be ____________ gallon capacity. Heater(s) shall have 150 psi working pressure and be equipped with extruded high density anode rod. All internal surfaces of the heater(s) exposed to water shall be glass-lined with an alkaline borosilicate composition that has been fused to steel by firing at a temperature range of 1400° to 1600°F. Electric heating elements shall be medium watt density with zinc plated copper sheath. Each element shall be controlled by an individually mounted thermostat and high temperature cutoff switch. The outer jacket shall be of baked enamel finish and shall be provided with full size control compartment for performance of service and maintenance through hinged front panels and shall enclose the tank with foam insulation. Electrical junction box with heavy duty terminal block shall be provided. The drain valve shall be located in the front for ease of servicing. Heater tank shall have a three year limited warranty as outlined in the written warranty. Fully illustrated instructions manual to be included.

A. O. Smith
Water Products Company
Irving, TX
A Division of A. O. Smith Corporation

A. O. Smith Corporation reserves the right to make product changes or improvements at any time without notice.

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SOLAR DOMESTIC WATER HEATER: ENERGY SAVINGS AND ECONOMIC CALCULATIONS

LIFE CYCLE COST ANALYSIS SUMMARY
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)

LOCATION: Fort A.P. Hill, Virginia REGION: 3 PROJECT NO.: DACA 31-89-C-0198
PROJECT TITLE: Fort A.P. Hill- Energy Engineering Analysis Program FISCAL YEAR: 1994
DISCRETE PORTION NAME: Solar Water Heater
ANALYSIS DATE: January 1994 ECONOMIC LIFE (YRS) 10 PREPARER: JJS

1. INVESTMENT COSTS:

A. CONSTRUCTION COST	$	156,122	
B. SIOH	$	8,587	
C. DESIGN COST	$	9,367	
D. TOTAL COST (1A+1B+1C)	$	174,076	
E. SALVAGE VALUE OF EXISTING EQUIPMENT			
F. PUBLIC UTILITY COMPANY REBATE			
G. TOTAL INVESTMENT (1D-1E-1F)			$174,076

2. ENERGY SAVINGS (+)/COST(-):

DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS- Oct 1992

ENERGY SOURCE	COST $/MBTU(1)	SAVING(S) MBTU/YR(2)	ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELEC	$20.67		$		$
B. DIST	$5.69	1,152.0	$ 6,555	9.48	$ 62,140
C. RESID			$		$
D. NG			$		$
E. LPG	$7.76		$		$
F. COAL			$		$
G. SOLAR			$		$
H. GEOTH			$		$
I. BIOMA			$		$
J. REFUS			$		$
K. WIND			$		$
L. OTHER			$		$
M. DEMAND SAVINGS			$		$
N. TOTAL		1,152	$ 6,555		$ 62,140

3. NON ENERGY SAVINGS (+) OR COST (-):

A. ANNUAL RECURRING (+/-)
(1) DISCOUNT FACTOR (TABLE A)
(2) DISCOUNTED SAVINGS/COST (3A X 3A1)

B. NON RECURRING SAVINGS (+) OR COST (-)

ITEM	SAVINGS(+) COST(-)(1)	YEAR OF OCCUR. (2)	DISCOUNT FACTOR(3)	DISCOUNTED SAVINGS(+)COST(-)(4)
a.	$			$
b.	$			$
c.	$			$
d. TOTAL				$

C. TOTAL NON ENERGY DISCOUNTED SAVINGS (3A2+3Bd4)

4. SIMPLE PAYBACK 1G/(2N3+3A+(3Bd1/ECONOMIC LIFE)):	26.56 YEARS
5. TOTAL NET DISCOUNTED SAVINGS (2N5+3C):	$62,140
6. SAVINGS TO INVESTMENT RATION (SIR) 5/1G:	0.36
7. ADJUSTED INTERNAL RATE OF RETURN (AIRR):	-10.18%

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CONSTRUCTION COST ESTIMATE

Activity and Location:
Energy Savings Opportunity Survey
Fort A. P. Hill, Virginia

Project: Solar Water Heater

Date Prepared: 1/27/94

Constr. Contact No. DACA 31-89-C-0198

Estimated By: EAC, P.C.

Status: Final

I.D. No.

Category Code

Job Order No.

ITEM DESCRIPTION	QUANTITY		PRIME CONTRACTOR				SUBCONTRACTOR				TOTAL COST
			MATERIAL COST		LABOR COST		MATERIAL COST		LABOR COST		
SUMMARY	NUMBER	UNIT	UNIT COST	TOTAL	UNIT COST	TOTAL	UNIT COST	TOTAL	UNIT COST	TOTAL	
Subtotal				93,935		19,613					
DIRECT COSTS				93,935		19,613					
SUBTOTAL (DIRECT COSTS)				93,935		19,613					
Material Tax & Labor Taxes			5.0%	4,697	21.0%	4,119	5.0%		21.0%		
Overhead			15.0%	14,090	15.0%	2,942	15.0%		15.0%		
SUBTOTAL				112,722		26,673					
Profit			12.0%	13,527	12.0%	3,201	12.0%		12.0%		
SUBTOTAL				126,248		29,874					
Prime Overhead on Sub							5.0%		5.0%		
SUBTOTAL											
Prime Profit on Sub							5.0%		5.0%		
TOTAL COST				126,248		29,874					$156,122

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CONSTRUCTION COST ESTIMATE	Date Prepared: 1/27/94	Reference: 1982 MMM Design
Activity and Location: Energy Savings Opportunity Survey Fort A. P. Hill, Virginia	Constr. Contact No. DACA 31-89-C-0198	I.D. No.
	Estimated By: EAC, P.C.	Category Code
Project: Solar Water Heater	Status: Final	Job Order No.

ITEM DESCRIPTION	QUANTITY		PRIME CONTRACTOR				SUBCONTRACTOR				TOTAL COST
			MATERIAL COST		LABOR COST		MATERIAL COST		LABOR COST		
	NUMBER	UNIT	UNIT COST	TOTAL	UNIT COST	TOTAL	UNIT COST	TOTAL	UNIT COST	TOTAL	
Install Solar Collector Including Controls, Piping, etc.	20,645	SF	4.55	93,935	0.95	19,613					113,548
SUB - TOTAL				$93,935		$19,613					$113,548

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DESIGN ANALYSIS

- ☐ BUDGET
- ☒ PRELIMINARY
- ☐ FINAL
- ☐ OTHER ______

PROJECT NAME: A.P. HILL	PROJECT PART: SOLAR WATER HEATING	SPEC. DIVISION: ESTIMATE COST
DEPARTMENT: MECH.	COMPUTED BY: J.L.D DATE: 4-5-4	JOB NO:
SHEET NO: OF:	CHECKED BY: DATE:	SHEET NO: OF:

SOLAR COLLECTORS

BUILDING #821 (E-1) 7056 FT² (AVS. LATRINE)

COSTS

1600 FT² OF COLLECTOR W/ALL ASSY. = 24000 ($15/FT²)
LABOR 4,900 ($3/FT²)
AVG COST FOR SOLAR COLL. IS $18. PER FT² INSTALLED TOTAL = $29,900.

TOTAL COST PER FT² OF BUILDING =

MAT. $\frac{24,000}{7056\ FT^2}$ = 3.40 FT² FOR MAT.

LABOR. $\frac{4,900}{7056\ FT^2}$ .694 SAY $.70 FT² FOR LABOR

TOTAL FT² OF BUILDINGS APPLICABLE FOR USE W/SOLAR COLLECTORS ARE 20,645

ESCALATED ... F/15

LABOR (4900) 1.337 ≅ 6550

MATERIAL: (24000)(1.337) ≅ 32075

MAT = $\frac{32075}{7056\ Ft^2}$ = $4.55/Ft²

LABOR = $\frac{6550}{7056}$ = .928 ≅ $.95/Ft²

FM065.../0100

BUILDING GROUP ENERGY USAGE

Solar Heated Domestic Water

Sub BUILDING GROUP No	Study ~~SAMPLE~~ BUILDING	Approx. of ~~TOTAL~~ GROUP SQ.-FT.	~~SAMPLE~~ BUILDING GROUP AVERAGE BTU/FT^2-YR.			TOTAL BUILDING GROUP AVERAGE BTU/FT^2-YR. X 10^{6}		
			ELECTRIC	FUEL	TOTAL	ELECTRIC	FUEL	TOTAL
E-1	821	206215	—	55.3×10^3	55.8×10^3	—	1152.0	1152.0
BASE	TOTALS -						1152.0×10^6	[illegible]

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DESIGN ANALYSIS

☐ BUDGET
☐ PRELIMINARY
☐ FINAL
☐ OTHER

PROJECT NAME: FEA Fort Hill	PROJECT PART: Solar Domestic Water Htr	SPEC. DIVISION:
DEPARTMENT:	COMPUTED BY: EWB DATE: 4-5-82	JOB NO:
SHEET NO: OF:	CHECKED BY: DATE:	SHEET NO: OF:

STUDY BUILDING: # 821

a. 600 MAN LATRINE (E-1)
b. 7056 sq ft

ASSUMPTIONS:

- 150 MEN USE SHOWER PER DAY
  @ 13 GAL/PERSON/DAY = 1950 GAL/DAY

ENERGY CONSUMED:

PEAK ASSUMED ENERGY REQUIRED = -

$$Q = 150\text{ MEN} \times 13.0 \frac{\text{GAL}}{\text{DAY}\cdot\text{MAN}} \times \frac{8.34\#}{\text{GAL}} \times \frac{30\text{ DAY}}{\text{MO}} \times \frac{1\text{ BTU}}{\#\ {}^\circ F} \times ([illegible]^\circ F - [illegible]^\circ F)$$

$$= 41.8 \times 10^6\ \text{BTU/MO}$$

OCCUPANCY: PERMANENT CAMPSITES

PER CONVERSATION WITH Ms. ANNETTE BALLEW, FORT PICKETT PLANNING OFFICE, 100% OCCUPANCY IS ASSUMED BETWEEN MARCH AND DECEMBER. SEVENTY-FIVE (75%) PER CENT IS ASSUMED THE REMAINING PERIOD.

FRM065.08. J109

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DESIGN ANALYSIS

- ☐ BUDGET
- ☐ PRELIMINARY
- ☐ FINAL
- ☐ OTHER ______

PROJECT NAME:	PROJECT PART:	SPEC. DIVISION:
DEPARTMENT:	COMPUTED BY: DATE:	JOB NO:
SHEET NO: OF:	CHECKED BY: DATE:	SHEET NO: OF:

COLLECTOR PARAMETERS

1. COLLECTOR FACING SOUTH ± 12°

2. TILT = 39° ≅ LATITUDE

3. AREA : 1.5 GALLONS STORAGE / ft² COLLECTOR*

$$= \frac{\text{EXISTING STORAGE VOLUME}}{1.5\ \text{GAL}/\text{ft}^2}$$

$$= \frac{2400\ \text{GALLONS}}{1.5\ \text{GAL}/\text{ft}^2}$$

= 1600 ft² COLLECTOR AREA

4. $F_R \tau\alpha = .85$
   $F_R U_L = .63$
   } SOLAR COLLECTOR PERFORMANCE VALUES FROM COLLECTOR MANUFACTURER. (THESE VALUES ARE DESIGNATED "F'TA" AND "F'UL" RESPECTIVELY IN SOLAR F-CHART PROGRAM)

ENERGY SAVED / BLDG AREA

1 ENERGY INPUT SAVINGS $= \frac{39372 \times 10^6\ \text{BTU/YR}}{5434\ \text{sq ft}}$

$= 65.8 \times 10^6$ BTU/sq ft YR

* Reference: G.O.G. LOF AND R.A. TYBOUT, "COST OF [illegible] HEATING WITH SOLAR [illegible]" SOLAR ENERGY, VOL [illegible] (1973)

FRM0065.08../0109

COLLECTOR AREA 1600.00 FT

% SUPPLIED	0.54	FR S	
DEMAND	41.80	MBTU	JAN
SUPPLIED	22.50	MBTU	
	0.66	FR S	
	41.80	MBTU	FEB
	27.57	MBTU	
	0.80	FR S	
	41.80	MBTU	MAR
	33.37	MBTU	
	0.91	FR S	
	41.80	MBTU	APR
	38.11	MBTU	
	0.93	FR S	
	41.80	MBTU	MAY
	38.92	MBTU	
	0.94	FR S	
	41.80	MBTU	JUN
	39.48	MBTU	
	0.94	FR S	
	41.80	MBTU	JUL
	39.16	MBTU	
	0.92	FR S	
	41.80	MBTU	AUG
	38.26	MBTU	
	0.87	FR S	
	41.80	MBTU	SEP
	36.48	MBTU	
	0.78	FR S	
	41.80	MBTU	OCT
	32.41	MBTU	
	0.62	FR S	
	41.80	MBTU	NOV
	26.01	MBTU	
	0.51	FR S	
	41.80	MBTU	DEC
	21.46	MBTU	

SOLAR F-CH
SCOTCH SE1
RICHMND VA

38.00	ANG	°TILT
0.85	F'TA	COLLECTOR FACTOR
0.63	F'UL	COLLECTOR FACTOR
0.00	HTG	
41.80	WTR	MBTU DEMAND

INPUT

OUTPUT

ANNUAL REQUIRED ENERGY	501.60	MBTU	ANNUAL
ENERGY PROVIDED BY SOLAR COLLECTORS	393.72	MBTU	SUMMARY
% ANNUAL ENERGY SUPPLIED	0.78	FR S	

TROMBE WALL RETROFIT: ENERGY SAVINGS AND ECONOMIC CALCULATIONS

LIFE CYCLE COST ANALYSIS SUMMARY
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)

LOCATION: Fort A.P. Hill, Virginia REGION: 3 PROJECT NO.: DACA 31-89-C-0198
PROJECT TITLE: Fort A.P. Hill- Energy Engineering Analysis Program FISCAL YEAR: 1994
DISCRETE PORTION NAME: Trombe Wall Retrofit
ANALYSIS DATE: January 1994 ECONOMIC LIFE (YRS) 20 PREPARER: JJS

1. INVESTMENT COSTS:

A. CONSTRUCTION COST	$	20	
B. SIOH	$	1	
C. DESIGN COST	$	1	
D. TOTAL COST (1A+1B+1C)	$	22	
E. SALVAGE VALUE OF EXISTING EQUIPMENT			
F. PUBLIC UTILITY COMPANY REBATE			
G. TOTAL INVESTMENT (1D-1E-1F)			$22

2. ENERGY SAVINGS (+)/COST(-):

DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS- Oct 1992

ENERGY SOURCE	COST $/MBTU(1)	SAVING(S) MBTU/YR(2)	ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELEC	$20.67		$		$
B. DIST	$5.69	0.1	$ 1	17.70	$ 10
C. RESID			$		$
D. NG			$		$
E. LPG	$7.76		$		$
F. COAL			$		$
G. SOLAR			$		$
H. GEOTH			$		$
I. BIOMA			$		$
J. REFUS			$		$
K. WIND			$		$
L. OTHER			$		$
M. DEMAND SAVINGS			$		$
N. TOTAL		0	$ 1		$ 10

3. NON ENERGY SAVINGS (+) OR COST (-):

A. ANNUAL RECURRING (+/-)
(1) DISCOUNT FACTOR (TABLE A)
(2) DISCOUNTED SAVINGS/COST (3A X 3A1)

B. NON RECURRING SAVINGS (+) OR COST (-)

ITEM	SAVINGS(+) COST(-)(1)	YEAR OF OCCUR. (2)	DISCOUNT FACTOR(3)	DISCOUNTED SAVINGS(+)COST(-)(4)
a.	$			$
b.	$			$
c.	$			$
d. TOTAL				$

C. TOTAL NON ENERGY DISCOUNTED SAVINGS (3A2+3Bd4)

4. SIMPLE PAYBACK 1G/(2N3+3A+(3Bd1/ECONOMIC LIFE)):	39.19 YEARS
5. TOTAL NET DISCOUNTED SAVINGS (2N5+3C):	$10
6. SAVINGS TO INVESTMENT RATION (SIR) 5/1G:	0.45
7. ADJUSTED INTERNAL RATE OF RETURN (AIRR):	-4.05%

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CONSTRUCTION COST ESTIMATE	Date Prepared: 1/27/94	
Activity and Location: Energy Savings Opportunity Survey Fort A. P. Hill, Virginia	Constr. Contact No. DACA 31-89-C-0198	I.D. No.
	Estimated By: EAC, P.C.	Category Code
Project: Trombe Wall System	Status: Final	Job Order No.

ITEM DESCRIPTION	QUANTITY		PRIME CONTRACTOR				SUBCONTRACTOR				TOTAL COST
			MATERIAL COST		LABOR COST		MATERIAL COST		LABOR COST		
SUMMARY	NUMBER	UNIT	UNIT COST	TOTAL	UNIT COST	TOTAL	UNIT COST	TOTAL	UNIT COST	TOTAL	
Subtotal				5		9					
DIRECT COSTS				5		9					
SUBTOTAL (DIRECT COSTS)				5		9					
Material Tax & Labor Taxes			5.0%	0	21.0%	2	5.0%		21.0%		
Overhead			15.0%	1	15.0%	1	15.0%		15.0%		
SUBTOTAL				6		12					
Profit			12.0%	1	12.0%	1	12.0%		12.0%		
SUBTOTAL				7		13					
Prime Overhead on Sub							5.0%		5.0%		
SUBTOTAL											
Prime Profit on Sub							5.0%		5.0%		
TOTAL COST				7		13					20

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CONSTRUCTION COST ESTIMATE	Date Prepared: 1/27/94	Reference: MMM Design 1982
Activity and Location: Energy Savings Opportunity Survey Fort A. P. Hill, Virginia	Constr. Contact No. DACA 31-89-C-0198	I.D. No.
	Estimated By: EAC, P.C.	Category Code
Project: Trombe Wall System	Status: Final	Job Order No.

ITEM DESCRIPTION	QUANTITY		PRIME CONTRACTOR				SUBCONTRACTOR				TOTAL COST
			MATERIAL COST		LABOR COST		MATERIAL COST		LABOR COST		
	NUMBER	UNIT	UNIT COST	TOTAL	UNIT COST	TOTAL	UNIT COST	TOTAL	UNIT COST	TOTAL	
1/4" Plexiglass or Kalwall Glazing	100	SF	2.85	285	2.24	224					509
Wood Frame	73	LF	0.12	9	0.37	27					36
Wood Glazing Bead	73	LF	0.19	14	0.65	47					61
Aluminum Flashing and Counterflashing	13	LF	1.50	20	1.42	18					38
Caulking	41	LF	0.98	40	1.70	70					110
2 Coats Flat Black Acrylic Latex Paint	100	SF	0.40	40	0.19	19					59
Concrete Block Cutout	10	EA			34.00	340					340
Interior Grille	10	EA	10.00	100	10.00	100					200
Screen and Poly. Damper	9	SF	1.62	15	1.39	13					27
Subtotal for 100 square foot trombe wall				$522		$858					$1,380

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ESTIMATE

☒ BUDGET
☐ PRELIMINARY
☐ FINAL
☐

SHEET NO. ______ OF ______
JOB NO. ______

PROJECT NAME: E.E.A.P.

DEPT. ______
SHEET ______ OF ______

PROJECT PART: TROMBE WALL SYSTEM

COMPUTED BY: TBT DATE: 9.15.82

SPEC. DIVISION:

CHECKED BY: TBT DATE:

ITEM NO.	DESCRIPTION	QUANTITY	UNIT	UNIT LAB. / UNIT MAT.	TOTAL COST
1)	1/4" PLEXIGLASS OR KALWALL GLAZING	100	S.F.	1.79/2.94	473.00
2)	WOOD FRAME	73	L.F.	0.37/0.12	35.77
3)	WOOD GLAZING BEAD	73	L.F.	0.65/0.19	61.32
4)	ALUMINUM FLASHING & COUNTERFLASHING	13	L.F.	1.20/1.21	31.33
5)	CAULKING	41	L.F.	0.65/0.35	41.00
6)	(2) COATS FLAT BLACK ACRYLIC LATEX PAINT	100	S.F.	0.34/0.15	49.00
7)	CONCRETE BLOCK CUTOUT	10	EA.	34.00/00	340.00
8)	INTERIOR GRILLE	10	EA.	8.72/8.78	175.00
9)	SCREEN & POLY. DAMPER	9	S.F.	1.39/1.62	27.09
	TOTAL FOR 100 S.F. TROMBE WALL:				1233.51

NOTES:
1) PRICE REFLECTS INSTALLED COST, INCLUDING SUBCONTRACTOR'S OVERHEAD & PROFIT.
2) COSTS BASED ON MEANS CONSTRUCTION COST DATA - 1982 EDITION.

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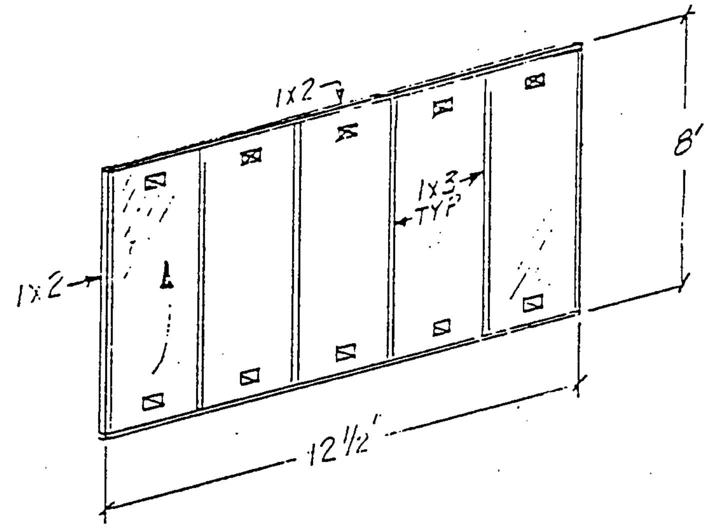
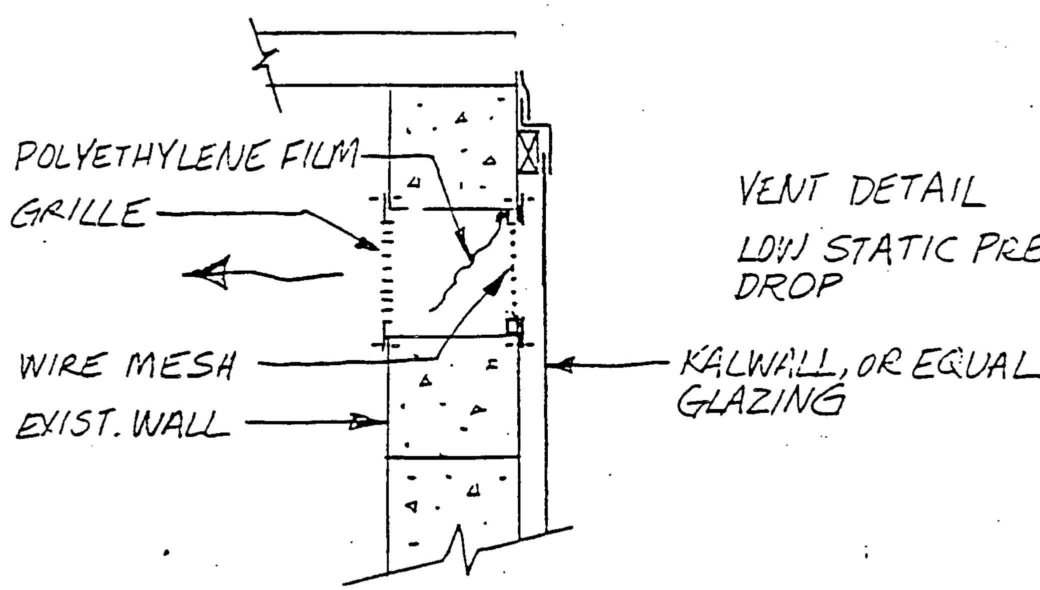
DESIGN ANALYSIS

☒ BUDGET
☐ PRELIMINARY
☐ FINAL
☐ OTHER

PROJECT NAME: EEAP	PROJECT PART: TROMBE WALL	SPEC. DIVISION: COST. ESTIMATE
DEPARTMENT: MECHANICAL	COMPUTED BY: CTW DATE:	JOB NO: 4617
SHEET NO: OF:	CHECKED BY: DATE:	SHEET NO: OF:



TYPICAL 100 FT² PANEL WITH THERMOSIPHONING VENTS



VENT DETAIL
LOW STATIC PRESSURE DROP

ELIMINATION OF VENTS WOULD REDUCE FIRST COST BY 44%, WHILE REDUCING THE SOLAR SAVINGS FRACTION BY ABOUT 35%. HOWEVER, THIS WOULD CAUSE OVER-HEATING OF BOTH PAINT AND WALL, GREATLY INCREASING MAINTENANCE COSTS.

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DESIGN ANALYSIS

☐ BUDGET
☐ PRELIMINARY
☒ FINAL
☐ OTHER

PROJECT NAME: EEAP - A P HILL	PROJECT PART: TROMBE WALL	SPEC. DIVISION:
DEPARTMENT: MECHANICAL	COMPUTED BY: DATE:	JOB NO: 5417
SHEET NO: OF:	CHECKED BY: DATE:	SHEET NO: OF:

ENERGY SAVINGS FOR TROMBE WALL RETROFITS ARE ESTIMATED USING PROCEDURES DESCRIBED IN

PASSIVE SOLAR DESIGN HANDBOOK

VOLUME TWO OF TWO VOLUMES:
PASSIVE SOLAR DESIGN ANALYSIS
PREPARED FOR USDOE BY LOS ALAMOS SCIENTIFIC LABORATORY, [illegible]
BALCOMB, ET. AL. 1980, DOE/CS-[illegible], 2

THE BASIC TROMBE WALL MODEL HAS THE FOLLOWING PARAMETERS:

THERMAL STORAGE = 45 BTU/FT²-F [illegible]
DOUBLE GLAZING, 1/4" AIR GAP
TRANSMITTANCE = 0.747
VENTS AT TOP & BOTTOM WITH [illegible]
VENT AREA = 3% OF COLLECTOR AREA [illegible]
MASONRY PROPERTIES:
$K = 1.0$ BTU/FT-HR-F (THERMAL CONDUCTIVITY)
$\rho = 150$ LB/FT³ (DENSITY)
$C = 0.2$ BTU/LB-F (SPECIFIC HEAT)
COLLECTOR ORIENTATION DUE SOUTH

SENSITIVITY TO PARAMETER VARIATIONS

WALL CONSTRUCTION - C8-8 IN HW CONCRETE BLOCK

$L = 0.6670'$ $K = 0.6000$ $\rho = 61.0$ $C = 0.200$

1. THERMAL STORAGE = $\rho CL = 8.14$ (VS 45 BASE)

THE BASE CASE ASSUMES THAT OTHER THERMAL MASS OF THE BUILDING IS NEGLIGIBLE, HOWEVER FOR MASONRY BLDG RETROFIT, THE TROMBE WALL REPRESENTS LESS THAN 1/4, SAY 20%, OF THE TOTAL WALL. THEN $\rho CL \approx (1/0.20) \times 8.14 = 41$
PERFORMANCE VARIATION IS NEGLIGIBLE FOR $\rho CL = 2$[illegible]

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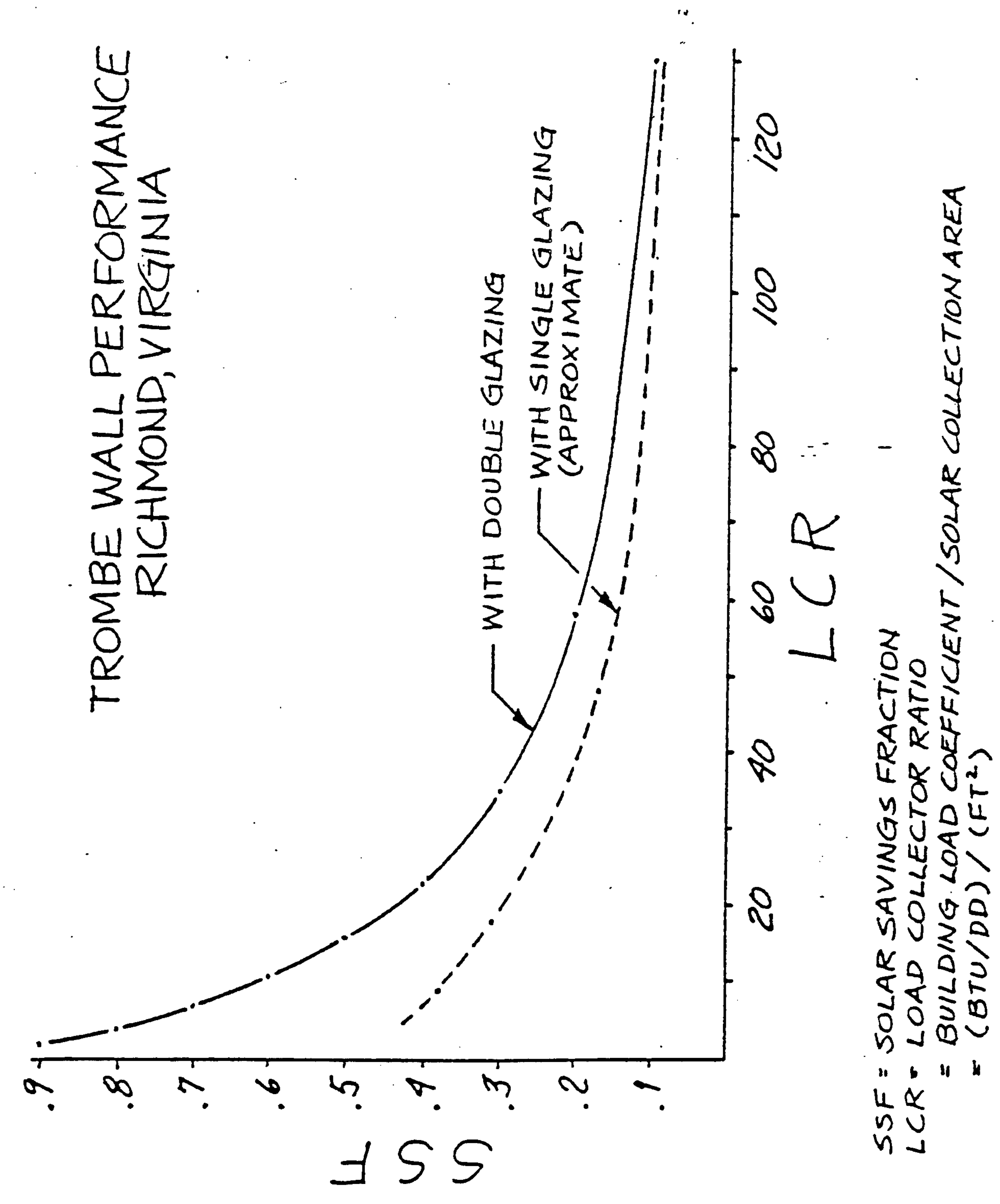
DESIGN ANALYSIS

☐ BUDGET
☐ PRELIMINARY
☒ FINAL
☐ OTHER ________

PROJECT NAME: EEAP - A P HILL	PROJECT PART: TROMBE WALL	SPEC. DIVISION: ENERGY SAVINGS
DEPARTMENT: MECHANICAL	COMPUTED BY: [illegible] DATE: [illegible]	JOB NO: [illegible]
SHEET NO: OF:	CHECKED BY: DATE:	SHEET NO: OF:



SSF = SOLAR SAVINGS FRACTION
LCR = LOAD COLLECTOR RATIO
= BUILDING LOAD COEFFICIENT / SOLAR COLLECTION AREA
= (BTU/DD) / (FT^2)

REFERENCE : PASSIVE SOLAR DESIGN HANDBOOK , VOL. 2 OF 2, P. F26

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DESIGN ANALYSIS

☐ BUDGET
☐ PRELIMINARY
☒ FINAL
☐ OTHER

PROJECT NAME: EEAP - A P HILL	PROJECT PART: TROMBE WALL	SPEC. DIVISION: ENERGY SAVINGS
DEPARTMENT: MECHANICAL	COMPUTED BY: CTW DATE: 9/3/82	JOB NO: 4417
SHEET NO: OF:	CHECKED BY: DATE:	SHEET NO: OF:

2. THERMAL TRANSFER = ρCK = 7.32 (VS 30 BASE)

IN MILD CLIMATES, SSF DOES NOT VARY APPRECIABLY FOR ρCK: 7 TO 30

IN MORE SEVERE CLIMATES, PERFORMANCE IMPROVES WITH ρCK DECREASE, BUT ONLY FOR VERY LARGE COLLECTORS (LCR < 15)

3. THE EFFECT OF ORIENTATION IS RELATIVELY SMALL FOR SMALL DEVIATIONS FROM SOUTH. FOR ORIENTATION OF 20°E TO 30°W, ANNUAL PERFORMANCE VARIATION IS LESS THAN 10%

4. WIND VELOCITIES USED IN SSF DEVELOPEMENT WERE NOT ADJUSTED FOR GROUND EFFECT. THEREFOR, ENERGY SAVINGS ESTIMATES ARE CONSERVATIVE.

TROMBE WALL RETROFIT FOR HEATED MASONRY BLDGS

ASSUME 20 FT^2 COLLECTOR AREA INCREMENTS (1 PANEL)
VENT AREA = .03 x 20 = 0.6 FT^2 ≈ 1 BLOCK (TOP/BOTTOM)

BLC = BUILDING LOAD COEFFICIENT IN BTU/DD, EXCLUSIVE OF COLLECTOR AREA

≈ ANNUAL HEATING LOAD / ANNUAL DEGREE DAYS
− BTU/DD LOAD FOR COLLECTOR AREA OF EXIST. WALL

ANNUAL DEGREE DAYS (BLAST) = 4452

WALL U VALUE = 0.07 BTU/HR-FT^2-°F (WITH 3½" DRYVIT)

WALL ADJUSTMENT = 0.07 x 20 FT^2 x 24 HR = 34 BTU/DD PANEL

BLC = ANNUAL HEATING LOAD / 4452 − 34 x (NO. OF PANELS, N)

LCR = BLC / FT^2 COLLECTOR

LCR = (ANNUAL HEATING LOAD / 4452 − 34 x N) / 20 x N

LCR = ANNUAL HEATING LOAD / 89000 x N − 1.7

SSF = SOLAR SAVINGS FRACTION
= FRACTION OF TOTAL HEATING LOAD SUPPLIED BY TROMBE WALL COLLECTOR

MAXIMUM INCREMENTAL BENEFITS ARE REALIZED FOR SMALL VALUES OF SSF, THAT IS, EACH ADDITIONAL SQUARE FOOT OF COLLECTOR DELIVERS SLIGHTLY LESS USABLE HEAT. FOR MAXIMUM COST/BENEFITS:

SSF = 0.09

LCR = 130 BTU/DD-FT^2

PER FT^2 OF COLLECTOR:

BLC = 130 x 1 = 130 BTU/DD

HEATING = SSF x BLC x DD

= 0.09 x 130 BTU/DD x 4452 DD

HEATING = 52000 BTU

THE NET HEAT GAIN FOR THE COLLECTOR MUST BE COMPARED WITH THE HEAT LOSS WITHOUT THE COLLECTOR; PER FT^2:

HEAT LOSS = 0.4 BTU/HR °F x 24 HR x 4452 DD

HEAT LOSS = 43000 BTU

SAVINGS/FT^2-YR = 43000 + 52000 = 95000 BTU

THESE SAVINGS ARE ADJUSTED USING THE ASHRAE MODIFIED DEGREE DAY METHOD (1980 SYSTEMS, pp 43.8, 43.9):

NET SAVINGS = 95000 x (.65/.55) = 112000 MBTU

PHOTOCELL AND TIME CLOCK LIGHTING CONTROLS: ENERGY SAVINGS AND ECONOMIC CALCULATIONS

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LIFE CYCLE COST ANALYSIS SUMMARY
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)

LOCATION: Fort A.P. Hill, Virginia   REGION: 3   PROJECT NO.: DACA 31-89-C-0198
PROJECT TITLE: Fort A.P. Hill- Energy Engineering Analysis Program   FISCAL YEAR: 1994
DISCRETE PORTION NAME: Photocell and Time Clock Lighting Controls
ANALYSIS DATE: January 1994   ECONOMIC LIFE (YRS) 15   PREPARER: JJS

1. INVESTMENT COSTS:

A. CONSTRUCTION COST	$	679	
B. SIOH	$	37	
C. DESIGN COST	$	41	
D. TOTAL COST (1A+1B+1C)	$	757	
E. SALVAGE VALUE OF EXISTING EQUIPMENT			
F. PUBLIC UTILITY COMPANY REBATE			
G. TOTAL INVESTMENT (1D-1E-1F)			$757

2. ENERGY SAVINGS (+)/COST(-):

DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS- Oct 1992

ENERGY SOURCE	COST $/MBTU(1)	SAVING(S) MBTU/YR(2)	ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELEC	$20.67	21.1	$ 436	11.77	$ 5,133
B. DIST	$5.69		$		$
C. RESID			$		$
D. NG			$		$
E. LPG	$7.76		$		$
F. COAL			$		$
G. SOLAR			$		$
H. GEOTH			$		$
I. BIOMA			$		$
J. REFUS			$		$
K. WIND			$		$
L. OTHER			$		$
M. DEMAND SAVINGS			$		$
N. TOTAL		21	$ 436		$ 5,133

3. NON ENERGY SAVINGS (+) OR COST (-):

A. ANNUAL RECURRING (+/-)
(1) DISCOUNT FACTOR (TABLE A)
(2) DISCOUNTED SAVINGS/COST (3A X 3A1)

B. NON RECURRING SAVINGS (+) OR COST (-)

ITEM	SAVINGS(+) COST(-)(1)	YEAR OF OCCUR. (2)	DISCOUNT FACTOR(3)	DISCOUNTED SAVINGS(+)COST(-)(4)
a.	$			$
b.	$			$
c.	$			$
d. TOTAL				$

C. TOTAL NON ENERGY DISCOUNTED SAVINGS (3A2+3Bd4)

4. SIMPLE PAYBACK 1G/(2N3+3A+(3Bd1/ECONOMIC LIFE)): 1.74 YEARS
5. TOTAL NET DISCOUNTED SAVINGS (2N5+3C): $5,133
6. SAVINGS TO INVESTMENT RATION (SIR) 5/1G: 6.78
7. ADJUSTED INTERNAL RATE OF RETURN (AIRR): 14.15%

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CONSTRUCTION COST ESTIMATE	Date Prepared: 1/27/94	
Activity and Location: Energy Savings Opportunity Survey Fort A. P. Hill, Virginia	Constr. Contact No. DACA 31-89-C-0198	I.D. No.
	Estimated By: EAC, P.C.	Category Code
Project: Photo Cell and Time Clock	Status: Final	Job Order No.

ITEM DESCRIPTION	QUANTITY		PRIME CONTRACTOR				SUBCONTRACTOR				TOTAL COST
			MATERIAL COST		LABOR COST		MATERIAL COST		LABOR COST		
SUMMARY	NUMBER	UNIT	UNIT COST	TOTAL	UNIT COST	TOTAL	UNIT COST	TOTAL	UNIT COST	TOTAL	
Subtotal				135		370					
DIRECT COSTS				135		370					
SUBTOTAL (DIRECT COSTS)				135		370	10.0%				
Material Tax & Labor Taxes			5.0%	7	5.0%	19	5.0%		21.0%		
Overhead			15.0%	20	15.0%	56	15.0%		15.0%		
SUBTOTAL				162		444					
Profit			12.0%	19	12.0%	53	12.0%		12.0%		
SUBTOTAL				181		498					
Prime Overhead on Sub							5.0%		5.0%		
SUBTOTAL											
Prime Profit on Sub							5.0%		5.0%		
TOTAL COST				181		498					$679

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CONSTRUCTION COST ESTIMATE	Date Prepared: 1/27/94	Reference: MMM Design 1982/RS Means 1992
Activity and Location: Energy Savings Opportunity Survey Fort A. P. Hill, Virginia	Constr. Contact No. DACA 31-89-C-0198	I.D. No.
	Estimated By: EAC, P.C.	Category Code
Project: Photo Cell and Time Clock	Status: Final	Job Order No.

ITEM DESCRIPTION	QUANTITY		PRIME CONTRACTOR				SUBCONTRACTOR				TOTAL COST
			MATERIAL COST		LABOR COST		MATERIAL COST		LABOR COST		
	NUMBER	UNIT	UNIT COST	TOTAL	UNIT COST	TOTAL	UNIT COST	TOTAL	UNIT COST	TOTAL	
#12 wire	15	CLF	6.00	90	19.00	285					375
Junction Box	2	E	1.50	3	10.45	21					24
3/4" Conduit	15	LF	1.00	15	2.03	30					45
Photo Cell	1	EA	12.00	12	14.00	14					26
Pitch Pockett	1	EA	15.00	15	20.00	20					35
Subtotal				$135		$370					$505

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DESIGN ANALYSIS

■ BUDGET
□ PRELIMINARY
□ FINAL
□ OTHER

PROJECT NAME: EEA FORT HILL	PROJECT PART: BLDG 179	SPEC. DIVISION: LIGHTING
DEPARTMENT: ELECT	COMPUTED BY: CJA DATE: 3-16-82	JOB NO: 4417.01
SHEET NO: OF:	CHECKED BY: DATE:	SHEET NO: OF:

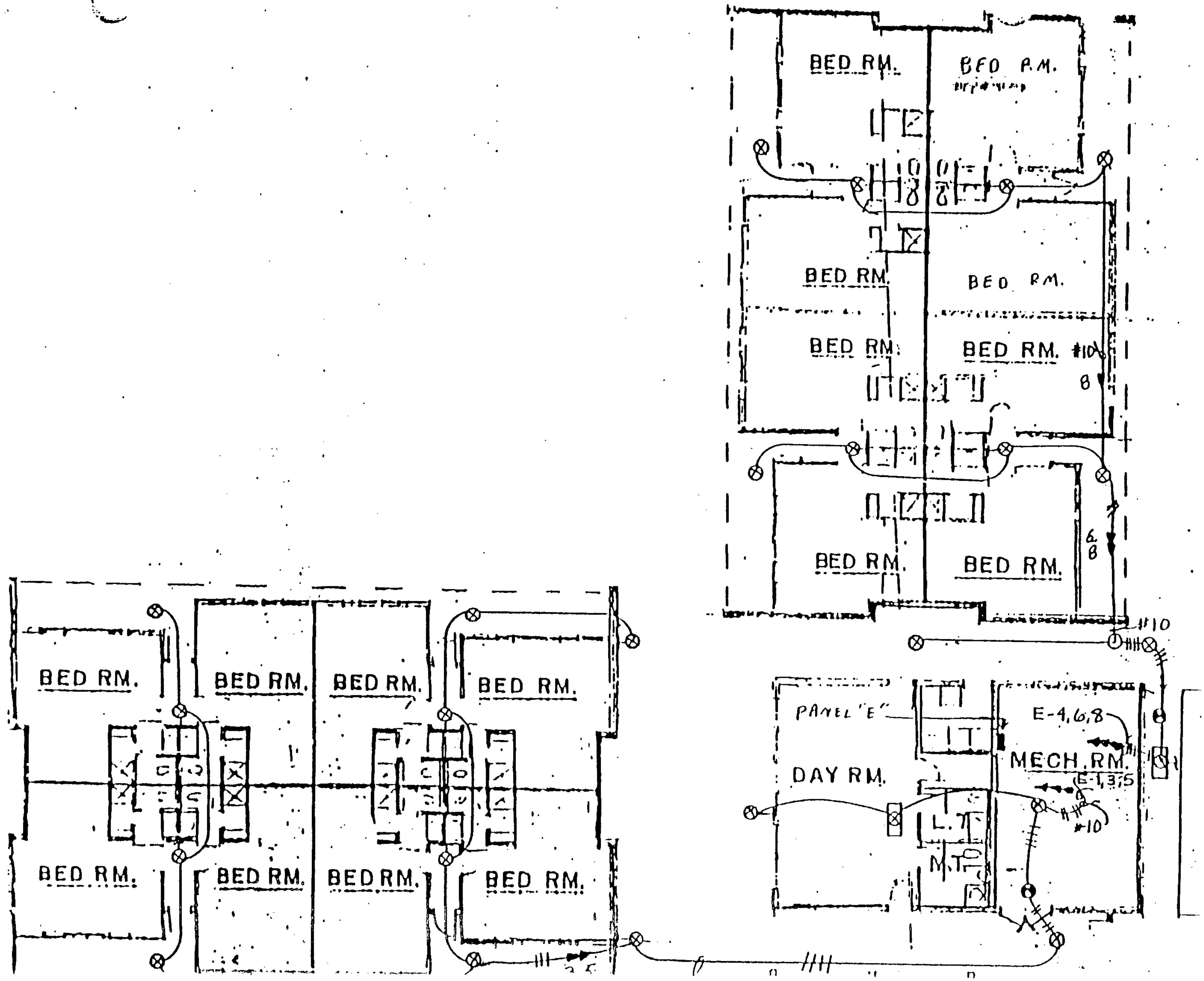
DURING OUR FIELD VISITS TO FORT HILL WE NOTICED THAT IN BUILDING 179 SOME EXTERIOR (CANOPY) LIGHTS WERE ON CONTINUOUSLY DAY AND NIGHT. ON THE PLANS THAT WERE PROVIDED TO US THESE LIGHTS ARE CALLED EMERGENCY LIGHTS. ACTUALLY THEY ARE NIGHT LIGHTS SINCE EMERGENCY POWER IS NOT PROVIDED. THEY ARE SIMPLY CONTROLLED BY CIRCUIT BREAKERS E-1, E-3, E-4, E-5, E-6, AND E-8. A FLOOR PLAN OF THE EXISTING LIGHTS IS SHOWN IN THE NEXT PAGE.

SINCE PART OF THESE LIGHTS DO NOT SERVE ANY PURPOSE BY BEING ON DURING THE DAY WE PROPOSE TO PUT THEM ON PHOTOCELL CONTROL, A FLOOR PLAN OF THE NEW (PROPOSED) LIGHTS IS FOLLOWING THE FLOOR PLAN OF THE EXISTING LIGHTS. CIRCUITS E-5 AND E-8 SHALL BE ON PHOTOCELL CONTROL AND CIRCUITS E-3 AND E-6 SHALL BE ON CONTINUOUSLY. THERE EXIST 1-100W LAMP IN EACH INCANDESCENT FIXTURE. THE PROPOSED DESIGN CALLS FOR 13 FIXTURES ON THE PHOTOCELL CONTROLLED CIRCUITS. THEREFORE WE HAVE 1300 W SAVINGS FOR AN AVERAGE OF 13 HOURS PER DAY WHOLE YEAR AROUND. TOTAL ENERGY SAVINGS PER YEAR:

$$(1300\,W)\left(13\,\frac{HOURS}{DAY}\right)\left(365\,\frac{DAYS}{YEAR}\right) = 6168.5\,\frac{KWH}{YEAR}$$

$$\left(6168.5\,\frac{KWH}{YEAR}\right)\left(\cancel{11600}\ 3413\,\frac{BTU}{KWH}\right) = \cancel{71.555}\ 21.1\,\frac{MBTU}{YEAR}$$

EXISTING-EXTERIOR EMERGENCY LIGHTS BLDG. 179



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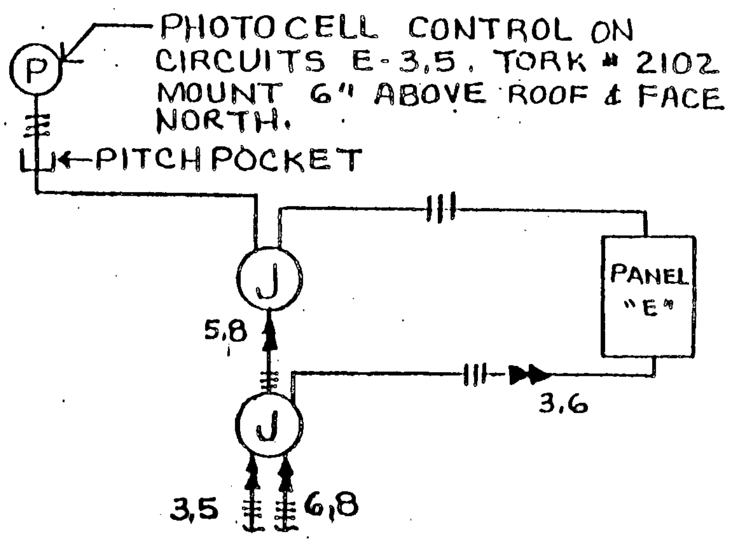
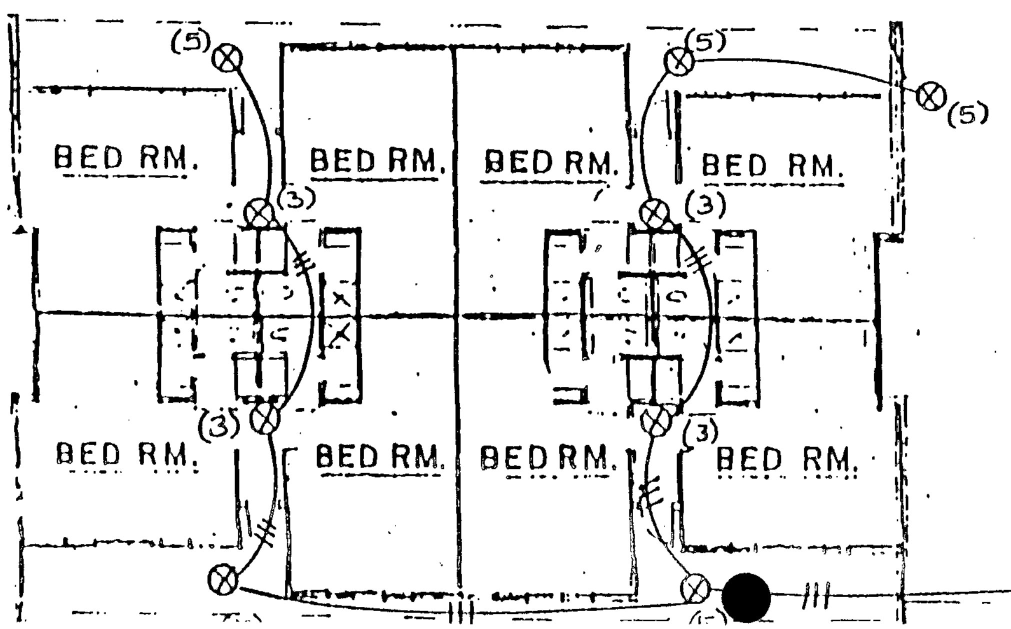
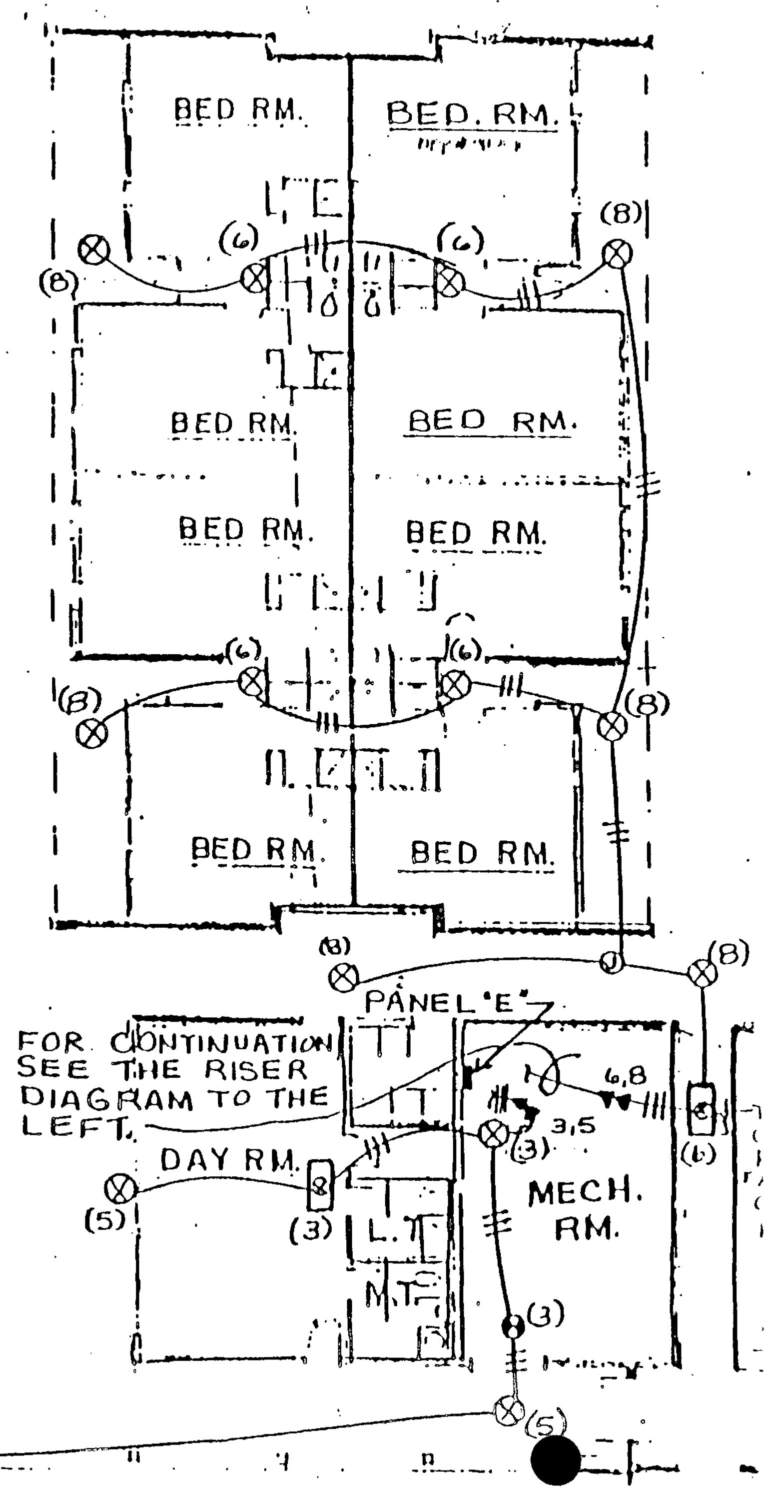
NEW - EXTERIOR EMERGENCY LIGHTS BLDG. 179

NOTES:

(1) AL WIRE ALL BE #12.
(2) RUN WIRE IN EXISTING CONDUIT



RISER DIAGRAM

REPLACING STANDARD FLUORESCENT LAMPS WITH HIGH EFFICIENCY TYPES: ENERGY SAVINGS AND ECONOMIC CALCULATIONS

LIFE CYCLE COST ANALYSIS SUMMARY
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)

LOCATION: Fort A.P. Hill, Virginia REGION: 3 PROJECT NO.: DACA 31-89-C-0198
PROJECT TITLE: Fort A.P. Hill- Energy Engineering Analysis Program FISCAL YEAR: 1994
DISCRETE PORTION NAME: Replacing Standard Fluorescent Lamps with High Efficiency Types
ANALYSIS DATE: January 1994 ECONOMIC LIFE (YRS) 15 PREPARER: JJS

1. INVESTMENT COSTS:

A. CONSTRUCTION COST	$	17,500	
B. SIOH	$	963	
C. DESIGN COST	$	1,050	
D. TOTAL COST (1A+1B+1C)	$	19,513	
E. SALVAGE VALUE OF EXISTING EQUIPMENT			
F. PUBLIC UTILITY COMPANY REBATE			
G. TOTAL INVESTMENT (1D-1E-1F)			$19,513

2. ENERGY SAVINGS (+)/COST(-):

DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS- Oct 1992

ENERGY SOURCE	COST $/MBTU(1)	SAVING(S) MBTU/YR(2)		ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)		DISCOUNTED SAVINGS(5)
A. ELEC	$20.67	493.1	$	10,192	11.77	$	119,964
B. DIST	$5.69	(74.8)	$	(426)	13.83	$	(5,886)
C. RESID			$			$	
D. NG			$			$	
E. LPG	$7.76		$			$	
F. COAL			$			$	
G. SOLAR			$			$	
H. GEOTH			$			$	
I. BIOMA			$			$	
J. REFUS			$			$	
K. WIND			$			$	
L. OTHER			$			$	
M. DEMAND SAVINGS			$			$	
N. TOTAL		418	$	9,767		$	114,078

3. NON ENERGY SAVINGS (+) OR COST (-):

A. ANNUAL RECURRING (+/-)
(1) DISCOUNT FACTOR (TABLE A)
(2) DISCOUNTED SAVINGS/COST (3A X 3A1)

B. NON RECURRING SAVINGS (+) OR COST (-)

ITEM		SAVINGS(+) COST(-)(1)	YEAR OF OCCUR. (2)	DISCOUNT FACTOR(3)		DISCOUNTED SAV-INGS(+)COST(-)(4)
a.	$				$	
b.	$				$	
c.	$				$	
d. TOTAL					$	

C. TOTAL NON ENERGY DISCOUNTED SAVINGS (3A2+3Bd4)

4. SIMPLE PAYBACK 1G/(2N3+3A+(3Bd1/ECONOMIC LIFE)):	2.00 YEARS
5. TOTAL NET DISCOUNTED SAVINGS (2N5+3C):	$114,078
6. SAVINGS TO INVESTMENT RATION (SIR) 5/1G:	5.85
7. ADJUSTED INTERNAL RATE OF RETURN (AIRR):	12.99%

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CONSTRUCTION COST ESTIMATE	Date Prepared: 1/27/94	
Activity and Location: Energy Savings Opportunity Survey, Fort A. P. Hill, Virginia	Constr. Contact No. DACA 31-89-C-0198	I.D. No.
	Estimated By: EAC, P.C.	Category Code
Project: Replace Fluorescent Lamps With High Efficiency Types	Status: Final	Job Order No.

ITEM DESCRIPTION	QUANTITY		PRIME CONTRACTOR				SUBCONTRACTOR				TOTAL COST
			MATERIAL COST		LABOR COST		MATERIAL COST		LABOR COST		
SUMMARY	NUMBER	UNIT	UNIT COST	TOTAL	UNIT COST	TOTAL	UNIT COST	TOTAL	UNIT COST	TOTAL	
Subtotal				11,074		3,510					
DIRECT COSTS				11,074		3,510					
SUBTOTAL (DIRECT COSTS)				11,074		3,510					
Material Tax & Labor Taxes			5.0%	554	5.0%	176	5.0%		21.0%		
Overhead			15.0%	1,661	15.0%	527	15.0%		15.0%		
SUBTOTAL				13,288		4,212					
Profit							12.0%		12.0%		
SUBTOTAL				13,288		4,212					
Prime Overhead on Sub							5.0%		5.0%		
SUBTOTAL											
Prime Profit on Sub							5.0%		5.0%		
TOTAL COST				13,288		4,212					$17,500

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CONSTRUCTION COST ESTIMATE	Date Prepared: 1/27/94	Reference: MMM Design 1982/RS Means
Activity and Location: Energy Savings Opportunity Survey Fort A. P. Hill, Virginia	Constr. Contact No. DACA 31-89-C-0198	I.D. No.
	Estimated By: EAC, P.C.	Category Code
Project: Replace Fluorescent Lamps With High Efficiency Types	Status: Final	Job Order No.

ITEM DESCRIPTION	QUANTITY		PRIME CONTRACTOR				SUBCONTRACTOR				TOTAL COST
			MATERIAL COST		LABOR COST		MATERIAL COST		LABOR COST		
	NUMBER	UNIT	UNIT COST	TOTAL	UNIT COST	TOTAL	UNIT COST	TOTAL	UNIT COST	TOTAL	
F30 T12 WMII	36	EA	3.45	124	1.50	54					178
F40 T12 WMII	1,044	EA	3.85	4,019	1.50	1,566					5,585
F96 T12 WMII	1,260	EA	5.50	6,930	1.50	1,890					8,820
SUBTOTAL				$11,074		$3,510					$14,584

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BUILDING GROUP ENERGY SAVINGS

FORT HILL - REPLACING FLUORESCENT LAMPS WITH HIGH EFFICIENCY TYPES

BUILDING GROUP	SAMPLE BUILDING	TOTAL GROUP SQ.-FT.	** SAMPLE BUILDING GROUP AVERAGE BTU/FT²-YR.			TOTAL BUILDING GROUP AVERAGE BTU -YR. X 10^6		
			ELECTRIC	FUEL	TOTAL	ELECTRIC	FUEL	TOTAL
A-1	101, 126, 214	122962	3142	-421	2721	386.35	-51.77	334.58
A-1 WINTERIZED	101, 126, 214	11,499	1932	-19	1913	22.2	-.20	22.00
A-2	*	8748	1932	-19	1913	16.9	-.17	16.73
B-1	-	-	-	-	-	-	-	-
B-2	1528	38,967	330	-78	252	12.86	-3.04	9.82
C-1	-	-	-	-	-	-	-	-
C-2	-	-	-	-	-	-	-	-
D-1	179.D'	6275	2968	-714	2254	18.62	-4.48	14.14
D-1 WINTERIZED	-	-	-			-	-	-
D-2	820	18,176	1991	-831	1160	36.20	-15.10	21.10
E-1	821	-	-		-	-	-	-
BASE	TOTALS -					493.13	-74.76	418.37

FEFM1-0182/0108

FORT HILL - - REPLACING STANDARD FLUORESCENT LAMPS WITH HIGH EFFIC.

BUILDING GROUP	SAMPLE BUILDING	SAMPLE BUILDING SQ.-FT.	TOTAL GROUP SQ.-FT	EXISTING NUMBER OF LAMPS PER SAMPLE BUILDING				PROPOSED NUMBER OF LAMPS PER TOTAL GROUP		
				F30T12	F40T12	F96T12		F30T12	F40T12	F96T12
A-1	101, 126, 214	18,761	122962		72	[illegible]			472	1081
A-1 WINTERIZED	101, 126, 214	18,761	11,499		72	[illegible]			45	102
A-2	*	18,761	8748		[illegible]	165			34	77
B-2	1528	7,563	38,967		16				83	
C-1	—	—	—	—	—	—		—	—	—
C-2	—	—	—	—	—	—		—	—	—
D-1	179	6275	6275	36	198			36	196	
D-2	820	6,176	18,176		[illegible]				212	
BASE	TOTALS -							36	1044	1260

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DESIGN ANALYSIS

■ BUDGET
☐ PRELIMINARY
☐ FINAL
☐ OTHER

PROJECT NAME: EEA	PROJECT PART: FORT HILL	SPEC. DIVISION: RE[illegible] FLUORESCENT LAMPS
DEPARTMENT: ELECTRICAL	COMPUTED BY: [illegible] DATE: 5-7-82	JOB NO: 4217.02
SHEET NO: OF:	CHECKED BY: DATE:	SHEET NO: OF:

CALCULATION OF LAMP ECONOMIC LIFE BASED ON WEIGHTED AVERAGES OF EACH OF 3 LAMP TYPES.

	TOTAL LAMPS	% OF TOTAL	LAMP LIFE	
F30T12	36	.01177	18 000 HRS	= 212 HRS
FAC T12	1968	.6435	20 000 HRS	= 12871 HRS
F96 T12	1054	.3447	12 000 HRS	= 4136 HRS
TOTAL	3058			17219 HOURS

$$\frac{\text{AVERAGE OPERATIONAL HOURS}}{\text{YEAR}} = \left(10 \frac{\text{HOURS}}{\text{DAY}}\right)\left(5 \frac{\text{DAYS}}{\text{WEEK}}\right)\left(52 \frac{\text{WEEKS}}{\text{YEAR}}\right) = 2600 \text{ H/Y}$$

$$\frac{17\,219 \text{ H}}{2600 \text{ H/Y}} = 6.62 \text{ YEARS}$$

FRM084.C.../0109

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DESIGN ANALYSIS

☐ PRELIMINARY
☐ FINAL
☐ OTHER

PROJECT NAME: EEA	PROJECT PART: A.P. HILL	SPEC. DIVISION: LIGHTING
DEPARTMENT: ELECTRICAL	COMPUTED BY: C.J.A DATE: 1/17/82	JOB NO: 4L17.02
SHEET NO: OF:	CHECKED BY: DATE:	SHEET NO: OF:

TYPE OF LAMPS	EXISTING (STANDARD) AVERAGED RATED LIFE (hours)	EXISTING (STANDARD) LAMP LUMENS	NEW (ENERGY SAVER) AVERAGED RATED LIFE (hours)	NEW (ENERGY SAVER) LAMP LUMENS	% LAMP LUMENS (N. / LAMP LUMENS (E.
F40T12CW	20000	3150	20000	3050	.968
F96T12 SL	12000	6300	12000	6000	.952
F96T12 HO	12000	9200	12000	9100	.989
F30T12	18000	2300	1800	2050	.891

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DESIGN ANALYSIS

- ■ BUDGET
- ☐ PRELIMINARY
- ☐ FINAL
- ☐ OTHER

PROJECT NAME: FFA	PROJECT PART: FORT STORY	SPEC. DIVISION: LIGHTING
DEPARTMENT: ELECTRICAL	COMPUTED BY: C.J.A DATE: 1-17-83	JOB NO: 4417.00
SHEET NO: OF:	CHECKED BY: DATE:	SHEET NO: OF:

TABLE OF STANDARD LAMPS AND THEIR CORRESPONDING ENERGY SAVER (THE "WATT-MISER" LAMP FAMILY)

Operating Characteristics	STANDARD LAMP (You are now using)	Nominal Watts	Color	AVAILABLE IN: Nominal Watts	WATT-MISER	WATT-MISER "II"
Rapid Start—36"	F30T12/CW/RS	30	Cool White	25	F30T12/CW/RS/WM	
	F30T12/WW/RS	30	Warm White	25	F30T12/WW/RS/WM	
Preheat—60"	F90T17/CW	90	Cool White	82	F90T17/CW/WM	
Rapid Start—Preheat—48"	F40CW	40	Cool White	35	(Rapid Start Only) †F40CW/RS/WM	(Rapid Start Only) †F40LW/RS/WM
	F40CWX	40	DeLuxe Cool White	35	†F40CWX/RS/WM	
	F40WWX	40	DeLuxe Warm White	35	†F40WWX/RS/WM	
	....		Rite-White	35	†F40RW3/RS/WM	
	F40D	40	Daylight	35	†F40D/RS/WM	
	F40W	40	White	35	†F40W/RS/WM	
	F40WW	40	Warm White	35	†F40WW/RS/WM	
Slimline—48" 425 Ma	F48T12/CW	40	Cool White	30	F48T12/CW/WM	F48T12/LW/WM
Slimline—96" 200 Ma	F96T8/CW	50	Cool White	40	F96T8/CW/WM	
Slimline—96" 425 Ma	F96T12/CW	75	Cool White	60	F96T12/CW/WM	F96T12/LW/WM
	F96T12/CWX	75	DeLuxe Cool White	60	F96T12/CWX/WM	
	F96T12/WWX	75	DeLuxe Warm White	60	F96T12/WWX/WM	
	....		Rite-White	60	F96T12/RW3/WM	
	F96T12/D	75	Daylight	60	F96T12/D/WM	
	F96T12/W	75	White	60	F96T12/W/WM	
	F96T12/WW	75	Warm White	60	F96T12/WW/WM	
	F96T12/C50	75	Chroma 50	60	F96T12/C50/WM	
High Output—96" 800 Ma	F96T12/CW/HO	110	Cool White	95	F96T12/CW/HO/WM	F96T12/LW/HO/W
	F96T12/CWX/HO	110	DeLuxe Cool White	95	F96T12/CWX/HO/WM	
	F96T12/WW/HO	110	Warm White	95	F96T12/WW/HO/WM	
Power Groove—48" 1500 Ma.	F48PG17/CW	110	Cool White	95	F48PG17/CW/WM	
Power Groove—96" 1500 Ma.	F96PG17/CW	215	Cool White	185	F96PG17/CW/WM	F96PG17/LW/W
	F96PG17/WW	215	Warm White	185	F96PG17/WW/WM	
1500 Ma—96"	F96T12/CW/1500	215	Cool White	185	F96T12/CW/1500/WM	

†For maximum efficiency, providing 20-24% more light output per watt than conventional "F-40" lighting installations, use with GE MAXI-MISER ballasts in GE MAXI-MISER™ lighting systems

NOTE: THE ABOVE TABLE WAS TAKEN FROM THE GENERAL ELECTRIC LAMP CATALOG.

FR-004.088

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DESIGN ANALYSIS

- [x] BUDGET
- [ ] PRELIMINARY
- [ ] FINAL
- [ ] OTHER ____________

PROJECT NAME: EEA	PROJECT PART: FORT HILL	SPEC. DIVISION: REPLACE FLUORESCENT LAMPS
DEPARTMENT: ELECTRICAL	COMPUTED BY: DGW DATE: 11-20-82	JOB NO: 4417.02
SHEET NO: OF:	CHECKED BY: DATE:	SHEET NO: OF:

APPLICABLE BUILDINGS

NON-WINTERIZED						WINTERIZED		ADDITIONAL NON-WINTERIZED
A-1						A-1		A-1
101	1227	326	361	1290	1296	121	506	113
103	1231	327	362	1219	1323	122	530	136
104	304	328	363	1301	1324	123	707	145
105	A-2	329	712	1401	1423	224	708	163
109	178	330	713	1501	1424	1201	804	201
115	226	331	715	1601	1425	1535	1320	214
116	512	332	364	1326	1474	A-2	1320	217
124	714	333	B-2	1327	1523	1630	1521	
126	807	334	253	1545	1524	1632	1522	242 TOTAL Bldgs
127	1304	335	1526	1546	1538	1633		
128	1404	336	1528	C-3	1623	1634		
129	1504	337	1529	108	1624	1650		
134	1604	338	1532	182	2002	1654		
135	B-1	339	1533	206	D-1	1656		
137	125	340	C-1	222	143	1664		
139	130	341	102	257	179B	1672		
140	131	342	106A	515	303	1673		
144	132	343	313	711	811	1677		
120	133	344	808	730	812	1679		
158	179A	345	1214	985	813	1683		
250	209	346	1224	986	814	1684		
251	211	347	1226	989	D-2	1685		
312	292	348	1282	1207	820	1687		
815	293	349	C-2	1208	1525	B-1		
816	294	350	148	1210	D-3	801		
817	[illegible]	351	149	1211	1204	1205		
818	309	352	151	1213B	175	C-1		
1220	310	353	219	1215	E-1	142		
1221	311	354	220	1216	305	708		
1225	320	355	258	1217	306	D-3		
1262	321	356	501	1226	821	1641		
1527	322	357	705	1230		1659		
2001	323	358	803	1268B		1690		
9071	324	359	1213	1293		E-1		
1206	325	360	1222	106B		227		

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HIGH EFFICIENCY TYPE MOTORS: ENERGY SAVINGS AND ECONOMIC CALCULATIONS

LIFE CYCLE COST ANALYSIS SUMMARY
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)

LOCATION: Fort A.P. Hill, Virginia REGION: 3 PROJECT NO.: DACA 31-89-C-0198
PROJECT TITLE: Fort A.P. Hill- Energy Engineering Analysis Program FISCAL YEAR: 1994
DISCRETE PORTION NAME: High Efficiency Motors
ANALYSIS DATE: January 1994 ECONOMIC LIFE (YRS) 20 PREPARER: JJS

1. INVESTMENT COSTS:

A. CONSTRUCTION COST	$	403	
B. SIOH	$	22	
C. DESIGN COST	$	24	
D. TOTAL COST (1A+1B+1C)	$	449	
E. SALVAGE VALUE OF EXISTING EQUIPMENT			
F. PUBLIC UTILITY COMPANY REBATE			
G. TOTAL INVESTMENT (1D-1E-1F)			$449

2. ENERGY SAVINGS (+)/COST(-):

DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS- Oct 1992

ENERGY SOURCE	COST $/MBTU(1)	SAVING(S) MBTU/YR(2)		ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)		DISCOUNTED SAVINGS(5)
A. ELEC	$20.67	4.1	$	85	86.00	$	7,288
B. DIST	$5.69		$			$	
C. RESID			$			$	
D. NG			$			$	
E. LPG	$7.76		$			$	
F. COAL			$			$	
G. SOLAR			$			$	
H. GEOTH			$			$	
I. BIOMA			$			$	
J. REFUS			$			$	
K. WIND			$			$	
L. OTHER			$			$	
M. DEMAND SAVINGS			$			$	
N. TOTAL		4	$	85		$	7,288

3. NON ENERGY SAVINGS (+) OR COST (-):

A. ANNUAL RECURRING (+/-)
(1) DISCOUNT FACTOR (TABLE A)
(2) DISCOUNTED SAVINGS/COST (3A X 3A1)

B. NON RECURRING SAVINGS (+) OR COST (-)

ITEM		SAVINGS(+) COST(-)(1)	YEAR OF OCCUR. (2)	DISCOUNT FACTOR(3)		DISCOUNTED SAV-INGS(+)COST(-)(4)
a.	$				$	
b.	$				$	
c.	$				$	
d. TOTAL					$	

C. TOTAL NON ENERGY DISCOUNTED SAVINGS (3A2+3Bd4)

4. SIMPLE PAYBACK 1G/(2N3+3A+(3Bd1/ECONOMIC LIFE)):	5.30 YEARS
5. TOTAL NET DISCOUNTED SAVINGS (2N5+3C):	$7,288
6. SAVINGS TO INVESTMENT RATION (SIR) 5/1G:	16.22
7. ADJUSTED INTERNAL RATE OF RETURN (AIRR):	15.55%

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CONSTRUCTION COST ESTIMATE

Date Prepared: 1/27/94

Activity and Location:
Energy Savings Opportunity Survey
Fort A. P. Hill, Virginia

Constr. Contact No. DACA 31-89-C-0198

I.D. No.

Estimated By: EAC, P.C.

Category Code

Project: High Efficiency Motors

Status: Final

Job Order No.

ITEM DESCRIPTION	QUANTITY		PRIME CONTRACTOR				SUBCONTRACTOR				TOTAL COST
			MATERIAL COST		LABOR COST		MATERIAL COST		LABOR COST		
SUMMARY	NUMBER	UNIT	UNIT COST	TOTAL	UNIT COST	TOTAL	UNIT COST	TOTAL	UNIT COST	TOTAL	
COST DIFFERENCE				300							300
DIRECT COSTS				300							
SUBTOTAL				300							
Material Tax & Labor Taxes			5.0%	15	5.0%		5.0%		21.0%		
Overhead			15.0%	45			15.0%		15.0%		
SUBTOTAL				360							
Profit			12.0%	43			12.0%		12.0%		
SUBTOTAL				403							
Prime Overhead on Sub							5.0%		5.0%		
SUBTOTAL											
Prime Profit on Sub							5.0%		5.0%		
TOTAL COST				403							$403

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CONSTRUCTION COST ESTIMATE	Date Prepared: 1/27/94	Reference: MMM Design 1982/GRAINGER INDUSTRIAL SUPPLIES
Activity and Location: Energy Savings Opportunity Survey Fort A. P. Hill, Virginia	Constr. Contact No. DACA 31-89-C-0198	I.D. No.
	Estimated By: EAC, P.C.	Category Code
Project: High Efficiency Motors	Status: Final	Job Order No.

ITEM DESCRIPTION	QUANTITY		PRIME CONTRACTOR				SUBCONTRACTOR				TOTAL COST
			MATERIAL COST		LABOR COST		MATERIAL COST		LABOR COST		
	NUMBER	UNIT	UNIT COST	TOTAL	UNIT COST	TOTAL	UNIT COST	TOTAL	UNIT COST	TOTAL	
25 HP High Efficiency Motor	1		1,100.00	1,100							1,100
25 HP Standard Motor	1		(800.00)	(800)							(800)
COST DIFFERENCE				$300							$300

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MMM DESIGN GROUP
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DESIGN ANALYSIS

■ BUDGET
□ PRELIMINARY
□ FINAL
□ OTHER ______

PROJECT NAME: EEA	PROJECT PART: FORT HILL	SPEC. DIVISION: HIGH EFFICIENCY TYPE MOTORS
DEPARTMENT: ELECTRICAL	COMPUTED BY: CJA DATE: 4/20/92	JOB NO: AA 17.00
SHEET NO: OF:	CHECKED BY: DATE:	SHEET NO: OF:

HIGH-EFFICIENCY TYPE MOTORS: THE MOTOR REPLACEMENTS CONSIDERED UNDER THIS PROJECT INCLUDE THE POTABLE WATER SYSTEM PUMP MOTORS AND SANITARY WASTE WATER SYSTEM PUMP MOTORS (BOOSTER PUMP TYPE, NOT SUBMERSIBLE LIFT TYPE). ENERGY SAVINGS REALIZED WILL BE A RESULT OF REDUCED ENERGY CONSUMPTION OF THE MOTORS. THE COST FACTOR WILL BE THE ADDITIONAL COST OF HIGH-EFFICIENCY MOTORS. SINCE THE EXISTING MOTORS ARE IN ACCEPTABLE CONDITION AND THE PROVISION OF ENERGY-EFFICIENT MOTORS WOULD BE EXPENSIVE, CONSIDERING LABOR COSTS AND PREMIUM PRICE, WE RECOMMEND THAT STANDARD TYPE MOTORS BE REPLACED BY HIGH EFFICIENCY MOTORS AS THEY NEED REPLACEMENT.

THERE EXIST TWO 400 GPM PUMPS (25 HP EACH) DISTRIBUTING 64.7 MG WATER PER YEAR.

1-25 HP → 30 KW

$$\frac{\frac{64.7}{2}\ G \times 10^6\ (1\ HR)}{(400\ \frac{G}{MIN.})\ (60\ MIN)} = 1348\ HRS/YR.$$

	25 HP STANDARD MOTOR	25 HP HIGH EFFICIENCY MOTOR
FIRST COST ($)	700	1000
EFFICIENCY	89	92
ELECTRICITY REQD. (KW)	30	29.1
HR USE/YR	1348	1348
KWH /YR	40440	39227
SAVINGS MBU/YR	0	14.07312

$$(40440 - 39227)\ KWH \times \frac{3413\ BTU}{[illegible]} \times \frac{1\ MBTU}{10^6\ BTU} = 4.14$$

DOMESTIC HOT WATER CIRCULATING PUMP CONTROLS: ENERGY SAVINGS AND ECONOMIC CALCULATIONS

LIFE CYCLE COST ANALYSIS SUMMARY
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)

LOCATION: Fort A.P. Hill, Virginia REGION: 3 PROJECT NO.: DACA 31-89-C-0198
PROJECT TITLE: Fort A.P. Hill- Energy Engineering Analysis Program FISCAL YEAR: 1994
DISCRETE PORTION NAME: Hot Water Circulating Pump Controls
ANALYSIS DATE: January 1994 ECONOMIC LIFE (YRS) 10 PREPARER: JJS

1. INVESTMENT COSTS:

A. CONSTRUCTION COST	$ 238	
B. SIOH	$ 13	
C. DESIGN COST	$ 14	
D. TOTAL COST (1A+1B+1C)	$ 265	
E. SALVAGE VALUE OF EXISTING EQUIPMENT		
F. PUBLIC UTILITY COMPANY REBATE		
G. TOTAL INVESTMENT (1D-1E-1F)		$265

2. ENERGY SAVINGS (+)/COST(-):

DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS- Oct 1992

ENERGY SOURCE	COST $/MBTU(1)	SAVING(S) MBTU/YR(2)	ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELEC	$20.67	2.8	$ 58	14.65	$ 848
B. DIST	$5.69		$		$
C. RESID			$		$
D. NG			$		$
E. LPG	$7.76		$		$
F. COAL			$		$
G. SOLAR			$		$
H. GEOTH			$		$
I. BIOMA			$		$
J. REFUS			$		$
K. WIND			$		$
L. OTHER			$		$
M. DEMAND SAVINGS			$		$
N. TOTAL		3	$ 58		$ 848

3. NON ENERGY SAVINGS (+) OR COST (-):

A. ANNUAL RECURRING (+/-)
(1) DISCOUNT FACTOR (TABLE A)
(2) DISCOUNTED SAVINGS/COST (3A X 3A1)

B. NON RECURRING SAVINGS (+) OR COST (-)

ITEM	SAVINGS(+) COST(-)(1)	YEAR OF OCCUR. (2)	DISCOUNT FACTOR(3)	DISCOUNTED SAVINGS(+)COST(-)(4)
a.	$			$
b.	$			$
c.	$			$
d. TOTAL				$

C. TOTAL NON ENERGY DISCOUNTED SAVINGS (3A2+3Bd4)

4. SIMPLE PAYBACK 1G/(2N3+3A+(3Bd1/ECONOMIC LIFE)):	4.59 YEARS
5. TOTAL NET DISCOUNTED SAVINGS (2N5+3C):	$848
6. SAVINGS TO INVESTMENT RATION (SIR) 5/1G:	3.20
7. ADJUSTED INTERNAL RATE OF RETURN (AIRR):	12.81%

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CONSTRUCTION COST ESTIMATE	Date Prepared: 1/27/94	
Activity and Location: Energy Savings Opportunity Survey Fort A. P. Hill, Virginia	Constr. Contact No. DACA 31-89-C-0198	I.D. No.
	Estimated By: EAC, P.C.	Category Code
Project: Hot Water Pump Controls	Status: Final	Job Order No.

ITEM DESCRIPTION	QUANTITY		PRIME CONTRACTOR				SUBCONTRACTOR				TOTAL COST
			MATERIAL COST		LABOR COST		MATERIAL COST		LABOR COST		
SUMMARY	NUMBER	UNIT	UNIT COST	TOTAL	UNIT COST	TOTAL	UNIT COST	TOTAL	UNIT COST	TOTAL	
Subtotal				134		38					
DIRECT COSTS				134		38					
SUBTOTAL (DIRECT COSTS)				134		38					
Material Tax & Labor Taxes			5.0%	7	21.0%	8					
Overhead			15.0%	20	15.0%	6					
SUBTOTAL				161		52					
Profit			12.0%	19	12.0%	6					
SUBTOTAL				180		58					
Prime Overhead on Sub											
SUBTOTAL											
Prime Profit on Sub											
TOTAL COST				180		58					$238

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CONSTRUCTION COST ESTIMATE	Date Prepared: 1/27/94	Reference: 1982 MMM Design Group\ 1992 RS Means
Activity and Location: Energy Savings Opportunity Survey Fort A. P. Hill, Virginia	Constr. Contact No. DACA 31-89-C-0198	I.D. No.
	Estimated By: EAC, P.C.	Category Code
Project: Hot Water Pump Controls	Status: Final	Job Order No.

ITEM DESCRIPTION	QUANTITY		PRIME CONTRACTOR				SUBCONTRACTOR				TOTAL COST
			MATERIAL COST		LABOR COST		MATERIAL COST		LABOR COST		
	NUMBER	UNIT	UNIT COST	TOTAL	UNIT COST	TOTAL	UNIT COST	TOTAL	UNIT COST	TOTAL	
Hot Water Pump Controls	1	EA	134.00	134	38.00	38					172
SUB - TOTAL				$134		$38					$172

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IN BUILDINGS WHICH HAVE DOMESTIC HOT WATER CIRCULATING PUMPS TO MAINTAIN WATER TEMPERATURE, ENERGY CAN BE SAVED BY SHUTTING OFF THE PUMP DURING UNOCCUPIED HOURS. ASSUMING BUILDING OCCUPANCY OF 8 HOURS PER DAY, 5 DAYS PER WEEK, THE UNOCCUPIED TIME REPRESENTS 128 HRS. PER WEEK.

THE SAVINGS FROM EACH 1/6 Hp. CIRCULATING PUMP IS:

$$1/6 \text{ Hp.} \times 2544 \ \text{BTU}/_{\text{Hp}\cdot\text{HR}} \times 128 \ \text{HR}/_{\text{WEEK}} \times 52 \ \text{WEEKS}/_{\text{YR.}}$$

$$= 2,822,144 \ \text{BTU}/_{\text{YR.}} = 2.8 \ \text{MBTU}/_{\text{YR.}}$$

~~THE APPROXIMATE COST OF A TIME CLOCK PLUS AN OPTIONAL THERMOSTATIC OVERRIDE (TO PREVENT PIPE FREEZING IN UNCONDITIONED SPACES) IS \$180 PER UNIT INSTALLED~~

ESCALATED COST = 180 × 1.034 × 1.067 × 1.067 × 1.034 = \$219.

CONVERSION FROM PUMP MBTU TO GENERATING PLANT MBTU:

$$2.8 \text{ MBTU} \left(\frac{11,600}{3,413}\right) = 9.5 \text{ MBTU/YR. SAVINGS}$$

INSULATED DAMPER PANELS: ENERGY SAVINGS AND ECONOMIC CALCULATIONS

LIFE CYCLE COST ANALYSIS SUMMARY
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)

LOCATION: Fort A.P. Hill, Virginia REGION: 3 PROJECT NO.: DACA 31-89-C-0198
PROJECT TITLE: Fort A.P. Hill- Energy Engineering Analysis Program FISCAL YEAR: 1994
DISCRETE PORTION NAME: Insulated Damper Panels
ANALYSIS DATE: January 1994 ECONOMIC LIFE (YRS) 20 PREPARER: JJS

1. INVESTMENT COSTS:

A. CONSTRUCTION COST	$	29	
B. SIOH	$	2	
C. DESIGN COST	$	2	
D. TOTAL COST (1A+1B+1C)	$	32	
E. SALVAGE VALUE OF EXISTING EQUIPMENT			
F. PUBLIC UTILITY COMPANY REBATE			
G. TOTAL INVESTMENT (1D-1E-1F)			$32

2. ENERGY SAVINGS (+)/COST(-):

DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS- Oct 1992

ENERGY SOURCE	COST $/MBTU(1)	SAVING(S) MBTU/YR(2)	ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELEC	$20.67		$		$
B. DIST	$5.69	2.4	$ 14	13.00	$ 178
C. RESID			$		$
D. NG			$		$
E. LPG	$7.76		$		$
F. COAL			$		$
G. SOLAR			$		$
H. GEOTH			$		$
I. BIOMA			$		$
J. REFUS			$		$
K. WIND			$		$
L. OTHER			$		$
M. DEMAND SAVINGS			$		$
N. TOTAL		2	$ 14		$ 178

3. NON ENERGY SAVINGS (+) OR COST (-):

A. ANNUAL RECURRING (+/-)
(1) DISCOUNT FACTOR (TABLE A)
(2) DISCOUNTED SAVINGS/COST (3A X 3A1)

B. NON RECURRING SAVINGS (+) OR COST (-)

ITEM	SAVINGS(+) COST(-)(1)	YEAR OF OCCUR. (2)	DISCOUNT FACTOR(3)	DISCOUNTED SAVINGS(+)COST(-)(4)
a.	$			$
b.	$			$
c.	$			$
d. TOTAL				$

C. TOTAL NON ENERGY DISCOUNTED SAVINGS (3A2+3Bd4)

4. SIMPLE PAYBACK 1G/(2N3+3A+(3Bd1/ECONOMIC LIFE)):	2.37 YEARS
5. TOTAL NET DISCOUNTED SAVINGS (2N5+3C):	$178
6. SAVINGS TO INVESTMENT RATION (SIR) 5/1G:	5.49
7. ADJUSTED INTERNAL RATE OF RETURN (AIRR):	9.24%

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CONSTRUCTION COST ESTIMATE	Date Prepared: 1/27/94	
Activity and Location: Energy Savings Opportunity Survey Fort A. P. Hill, Virginia	Constr. Contact No. DACA 31-89-C-0198	I.D. No.
	Estimated By: EAC, P.C.	Category Code
Project: Louver Insulated Panels	Status: Final	Job Order No.

ITEM DESCRIPTION	QUANTITY		PRIME CONTRACTOR				SUBCONTRACTOR				TOTAL COST
			MATERIAL COST		LABOR COST		MATERIAL COST		LABOR COST		
SUMMARY	NUMBER	UNIT	UNIT COST	TOTAL	UNIT COST	TOTAL	UNIT COST	TOTAL	UNIT COST	TOTAL	
Subtotal				14		4					
DIRECT COSTS				14		4					
Design contingency			10.0%	1	10.0%	0	10.0%				
SUBTOTAL (DIRECT COSTS)				16		5					
Material Tax & Labor Taxes			5.0%	1	21.0%	1	5.0%		21.0%		
Overhead			15.0%	2	15.0%	1	15.0%		15.0%		
SUBTOTAL				19		6					
Profit			12.0%	2	12.0%	1	12.0%		12.0%		
SUBTOTAL				21		7					
Prime Overhead on Sub							5.0%		5.0%		
SUBTOTAL											
Prime Profit on Sub							5.0%		5.0%		
TOTAL COST				21		7					$29

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CONSTRUCTION COST ESTIMATE	Date Prepared: 1/27/94	Reference: MMM Design 1982/RS MEANS 1992
Activity and Location: Energy Savings Opportunity Survey Fort A. P. Hill, Virginia	Constr. Contact No. DACA 31-89-C-0198	I.D. No.
	Estimated By: EAC, P.C.	Category Code
Project: Louver Insulated Panels	Status: Final	Job Order No.

ITEM DESCRIPTION	QUANTITY		PRIME CONTRACTOR				SUBCONTRACTOR				
			MATERIAL COST		LABOR COST		MATERIAL COST		LABOR COST		
	NUMBER	UNIT	UNIT COST	TOTAL	UNIT COST	TOTAL	UNIT COST	TOTAL	UNIT COST	TOTAL	TOTAL COST
1" Rigid Insulation	9	SF	1.00	9	0.18	2					11
3/4" Plywood	9	SF	0.60	5	0.30	3					8
SUBTOTAL				$14		$4					$19

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INSULATED PANELS FOR BACKDRAFT DAMPERS

SOME BUILDINGS AT FORT A.P. HILL MAY HAVE BACKDRAFT DAMPERS OR UNINSULATED PLYWOOD PANELS OVER EXHAUST FANS AND/OR VENTILLATING FANS. IN THE CASE WHERE THESE FANS DO NOT OPERATE IN THE WINTER MONTHS, TIGHT FITTING, INSULATED PANELS PLACED OVER THE OPENING WILL REDUCE HEAT LOSSES DUE TO INFILTRATION AND TRANSMISSION.

INFILTRATION CALCULATIONS

FOR INFILTRATION CALCULATION PURPOSES, THE EXISTING PANEL IS CONSIDERED TO BE OF SIMILAR FIT TO A POORLY FITTED DOOR, AND THE PROPOSED PANEL CONSIDERED SIMILAR TO A WELL FITTED DOOR.

THE 1981 ASHRAE FUNDAMENTALS GUIDE SUGGESTS THAT A WELL FITTED DOOR, INFILTRATION APPROXIMATES A POORLY FITTED DOUBLE-HUNG WINDOW, AND FOR A POORLY FITTED DOOR THIS FIGURE MAY BE DOUBLED. (CHAPTER 22.13) THE GUIDE ALSO STATES THAT THE LEAKAGE THROUGH A POOR FIT DOUBLE-HUNG WINDOW IS APPROXIMATELY 77 CFH PER LINEAR FOOT OF CRACK AT 15 MPH WINDSPEED. (0.10 IN W.C. PRESSURE). (CHAPTER 22.9, TABLE 3)

LOUVER SIZE = 3′ × 3′ LENGTH OF CRACK = 12 FT.

INFILTRATION RATE (EXISTING) = 12(77) = 924 CFH

INFILTRATION RATE (PROPOSED) = 12(77)2 = 1848 CFH

INFILTRATION REDUCTION = 1848 − 924 = 924 CFH

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DESIGN ANALYSIS

☐ BUDGET
☐ PRELIMINARY
■ FINAL
☐ OTHER

PROJECT NAME: FORT A.P. HILL	PROJECT PART: INSULATED PANELS	SPEC. DIVISION: INCREMENT "F"
DEPARTMENT: MECHANICAL	COMPUTED BY: EDC DATE: 8-27-82	JOB NO: 4417.01
SHEET NO: OF:	CHECKED BY: [illegible] DATE: 12-10-82	SHEET NO: 2 OF: 3

INFILTRATION CALCULATION (CONT.)

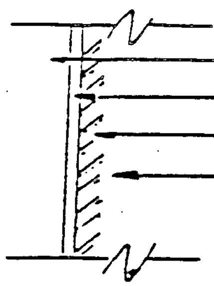
REDUCTION IN HEATING LOAD = $1.08\,(CFM)\,\Delta T$

$= 1.08\left(\frac{924}{60}\right)(68^{\circ}-22^{\circ})$

$= 765$ BTUH / PANEL

HEAT TRANSMISSION CALCULATIONS

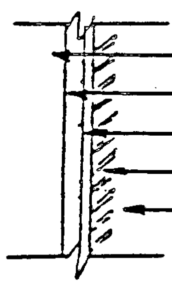
"U" VALUE EXISTING



	"R" VALUE
OUTSIDE AIR FILM	0.17
PLYWOOD PANEL	0.62
WOOD LOUVER	NEG.
INSIDE AIR FILM	0.68
	1.47

$U = 1/R = 1/1.47 = 0.68$

"U" VALUE PROPOSED



	"R" VALUE
OUTSIDE AIR FILM	0.17
1" RIGID INSULATION	4.00
PLYWOOD PANEL	0.62
WOOD LOUVER	NEG.
INSIDE AIR FILM	0.68
	5.47

$U = 1/R = 1/5.47 = 0.18$

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DESIGN ANALYSIS

☐ BUDGET
☐ PRELIMINARY
■ FINAL
☐ OTHER ______

PROJECT NAME: FORT A.P. HILL	PROJECT PART: INSULATED PANELS	SPEC. DIVISION: INC. "F"
DEPARTMENT: MECHANICAL	COMPUTED BY: BDC DATE: 8-27-82	JOB NO: 4417.01
SHEET NO: OF:	CHECKED BY: [illegible] DATE: 12-4-82	SHEET NO: 3 OF: 3

HEAT TRANSMISSION

HEAT LOSS = U(A)ΔT   PANEL AREA = 3 × 3   9 FT²

HEAT LOSS (EXISTING) = 0.68(9)(68-22) = 282 BTUH

HEAT LOSS (PROPOSED) = 0.19(9)(68-22) = 79 BTUH

REDUCTION IN HEATING LOAD = 282-79
= 203 BTUH/PANEL

TOTAL HEAT LOAD REDUCTION = 968 BTUH/PANEL

ANNUAL SAVINGS (MODIFIED DEGREE DAY METHOD)

$$E = \frac{H_L \times D \times 24}{\Delta T \times \eta}(C_D) = \frac{968(3939)24}{(68-22)(.55)}(.65)$$

E = 2351069 BTU/PANEL/YR = 2.35 MBTU/PANEL-YR.

REDUCTION OF WINDOW GLAZING: ENERGY SAVINGS AND ECONOMIC CALCULATIONS

LIFE CYCLE COST ANALYSIS SUMMARY

ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)

LOCATION: Fort A.P. Hill, Virginia REGION: 3 PROJECT NO.: DACA 31-89-C-0198
PROJECT TITLE: Fort A.P. Hill- Energy Engineering Analysis Program FISCAL YEAR: 1994
DISCRETE PORTION NAME: Reduction of Window Glazing
ANALYSIS DATE: January 1994 ECONOMIC LIFE (YRS) 20 PREPARER: JJS

1. INVESTMENT COSTS:

A. CONSTRUCTION COST	$	34	
B. SIOH	$	2	
C. DESIGN COST	$	2	
D. TOTAL COST (1A+1B+1C)	$	38	
E. SALVAGE VALUE OF EXISTING EQUIPMENT			
F. PUBLIC UTILITY COMPANY REBATE			
G. TOTAL INVESTMENT (1D-1E-1F)			$38

2. ENERGY SAVINGS (+)/COST(-):

DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS- Oct 1992

ENERGY SOURCE	COST $/MBTU(1)	SAVING(S) MBTU/YR(2)	ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELEC	$20.67		$		$
B. DIST	$5.69	1.6	$ 9	17.70	$ 161
C. RESID			$		$
D. NG			$		$
E. LPG	$7.76		$		$
F. COAL			$		$
G. SOLAR			$		$
H. GEOTH			$		$
I. BIOMA			$		$
J. REFUS			$		$
K. WIND			$		$
L. OTHER			$		$
M. DEMAND SAVINGS			$		$
N. TOTAL		2	$ 9		$ 161

3. NON ENERGY SAVINGS (+) OR COST (-):

A. ANNUAL RECURRING (+/-)
(1) DISCOUNT FACTOR (TABLE A)
(2) DISCOUNTED SAVINGS/COST (3A X 3A1)

B. NON RECURRING SAVINGS (+) OR COST (-)

ITEM	SAVINGS(+) COST(-)(1)	YEAR OF OCCUR. (2)	DISCOUNT FACTOR(3)	DISCOUNTED SAVINGS(+)COST(-)(4)
a.	$			$
b.	$			$
c.	$			$
d. TOTAL				$

C. TOTAL NON ENERGY DISCOUNTED SAVINGS (3A2+3Bd4)

4. SIMPLE PAYBACK 1G/(2N3+3A+(3Bd1/ECONOMIC LIFE)):	4.16 YEARS
5. TOTAL NET DISCOUNTED SAVINGS (2N5+3C):	$161
6. SAVINGS TO INVESTMENT RATION (SIR) 5/1G:	4.25
7. ADJUSTED INTERNAL RATE OF RETURN (AIRR):	7.80%

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CONSTRUCTION COST ESTIMATE	Date Prepared: 1/27/94	
Activity and Location: Energy Savings Opportunity Survey Fort A. P. Hill, Virginia	Constr. Contact No. DACA 31-89-C-0198 Estimated By: EAC, P.C.	I.D. No. Category Code
Project: Window Reduction	Status: Final	Job Order No.

ITEM DESCRIPTION	QUANTITY		PRIME CONTRACTOR				SUBCONTRACTOR				TOTAL COST
			MATERIAL COST		LABOR COST		MATERIAL COST		LABOR COST		
SUMMARY	NUMBER	UNIT	UNIT COST	TOTAL	UNIT COST	TOTAL	UNIT COST	TOTAL	UNIT COST	TOTAL	
Subtotal				11		11					
DIRECT COSTS				11		11					
Design contingency			10.0%	1	10.0%	1					
SUBTOTAL (DIRECT COSTS)				12		12					
Material Tax & Labor Taxes			5.0%	1	5.0%	1					
Overhead			15.0%	2	15.0%	2					
SUBTOTAL				15		15					
Profit			12.0%	2	12.0%	2					
SUBTOTAL				17		17					
Prime Overhead on Sub											
SUBTOTAL											
Prime Profit on Sub											
TOTAL COST				17		17					$34

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CONSTRUCTION COST ESTIMATE	Date Prepared: 1/27/94	Reference: MMM Design 1982/RS MEANS 1992
Activity and Location: Energy Savings Opportunity Survey Fort A. P. Hill, Virginia	Constr. Contact No. DACA 31-89-C-0198 Estimated By: EAC, P.C.	I.D. No. Category Code
Project: Window Reduction	Status: Final	Job Order No.

ITEM DESCRIPTION	QUANTITY		PRIME CONTRACTOR				SUBCONTRACTOR				TOTAL COST
			MATERIAL COST		LABOR COST		MATERIAL COST		LABOR COST		
	NUMBER	UNIT	UNIT COST	TOTAL	UNIT COST	TOTAL	UNIT COST	TOTAL	UNIT COST	TOTAL	
1/2" Plywood	16	SF	0.29	5	0.33	5					10
1" Rigid Polystyrene Board	16	SF	0.37	6	0.25	4					10
Paint/Primer (One Coat Each)	16	SF	0.05	1	0.13	2					3
SUBTOTAL				$11		$11					$23

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ENGINEERING ANALYSIS

Sheet 1 of 1

Date: December 7, 1992 By: JS

Project: Energy Savings Opportunity Survey, Fort A.P. Hill, VA

Contract No.: DACA 31-89-C-0198 EAC Project No.: 92008.00

REDUCTION OF WINDOW GLAZING:

PAINTING ON 7th & 10th yr — $ — PER WINDOW

REDUCTION OF WINDOW GLAZING

THIS PROJECT RECOMMENDS THE REDUCTION OF WINDOW GLAZING IN BUILDINGS WHERE NATURAL LIGHTING IS NOT REQUIRED. THE COVERING OF WINDOWS WITH INSULATED PLYWOOD WILL REDUCE THE INFILTRATION OF OUTSIDE AIR AND WILL REDUCE HEAT TRANSFER THROUGH THE WINDOW AREA. GREATER ENERGY SAVINGS COULD BE OBTAINED BY SIDING OVER THE PANELS. THIS WOULD IMPROVE THE HEAT TRANSFER COEFFICIENT AND WOULD HELP RETAIN THE APPEARANCE OF THE BUILDING.

FROM OUR EXPERIENCE, IT IS RECOMMENDED THAT WINDOWS ON THE SOUTH, SOUTH-EAST AND SOUTH-WEST SIDES NOT BE COVERED DUE TO THE SOLAR HEAT GAIN AND NATURAL LIGHTING OBTAINED THROUGH THESE WINDOWS. IT IS FURTHUR RECOMMENDED THAT WINDOWS ONLY BE COVERED IN AREAS THAT ARE NOT OCCUPIED ON A STEADY BASIS, DUE TO THE ADVERSE CLAUSTROPHOBIC EFFECT THIS PROJECT MAY HAVE ON PERSONNEL.

THIS PROJECT SHALL BE IMPLIMENTED "AS APPLICABLE", AS DETERMINED BY THE FACILITY ENGINEERS OFFICE.

CALCULATIONS

INFILTRATION:

* INFILTRATION THROUGH AN AVERAGE FIT, NON-WEATHERSTRIPPED, WOOD FRAME, DOUBLE-HUNG WINDOW IS APPROXIMATELY 27 CFH / LINEAR FT. (0.45 CFM / FT)

* INFILTRATION BETWEEN A WOOD FRAME WINDOW AND A STANDARD FRAME WALL IS APPROX. 13 CFH / FT. (0.217 CFM

* ESTIMATED INFILTRATION THROUGH A WOOD COVER OVER AN EXISTING WINDOW IS APPROX. 20 CFH / FT (0.333 CFM/ (SIMILAR TO STORM WINDOWS)

FOR A STD. 4' x 3' WINDOW, THE REDUCTION IN INFILTRATIO WOULD BE $[(27+13)-20] \times 14' = 280$ CFH $= 4.7$ CFM

*(1981 ASHRAE FUNDAMENTALS GUIDE, CH. 22.9 & TABLE 3)

DESIGN ANALYSIS

☐ BUDGET
☐ PRELIMINARY
■ FINAL
☐ OTHER

PROJECT NAME: Fort Hill	PROJECT PART: Reduction of Window	SPEC. DIVISION: Increment F
DEPARTMENT: Mech.	COMPUTED BY: BDC DATE: 8-30-82	JOB NO: 4417.01
SHEET NO: OF:	CHECKED BY: DATE:	SHEET NO: 2 OF:

INFILTRATION: (CONTINUED)

REDUCTION IN HEAT LOSS = REDUCED CFM × 1.08 × ΔT
= 4.7 (1.08)(55*-22)
= 168 BTUH

TRANSMISSION:

"U" VALUE (EXISTING)

1/8" GLASS WINDOW W/WOOD FRAME "U" = 0.935 BTU/HR·FT²·°

"U" VALUE (PROPOSED)

	"R" VALUE
INSIDE AIR FILM	0.68
1/8" WINDOW W/WOOD FRAME	0.22
AIRSPACE (2"	1.02
1" RIGID INSULATION	4.00
1/2" PLYWOOD	0.47
OUTSIDE AIR FILM	0.17
	R_T = 6.56

$U = 1/R_T = 1/6.56 = 0.15$

REDUCTION IN HEAT LOSS = ΔU(A)ΔT
= (.935 - .15)(3 × 4)(55*-22)
= 311 BTUH

TOTAL REDUCTION IN HEAT LOSS = 168 + 311 = 479 BTUH

* 55° TEMPERATURE ASSUMED TYPICAL AVERAGE BETWEEN INVOLVED BUILDINGS (WAREHOUSES, ETC)

NOTE: SOLAR HEAT GAIN FOR NON-SOUTH FACING WINDOWS IS CONSIDERED NEGLEGABLE.

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DESIGN ANALYSIS

☐ BUDGET
☐ PRELIMINARY
■ FINAL
☐ OTHER ______

PROJECT NAME: FORT A.P. HILL	PROJECT PART: WINDOW REDUCTION	SPEC. DIVISION: INCREMENT "F"
DEPARTMENT: MECHANICAL	COMPUTED BY: BDC DATE: 8-31-82	JOB NO: 4417.01
SHEET NO: OF:	CHECKED BY: DATE:	SHEET NO: 3 OF:

ANNUAL ENERGY SAVINGS

*MODIFIED DEGREE DAY METHOD

$$\text{MBTU SAVED / YR.} = \frac{(H_L)\,D\,(24)}{\Delta t \;\; \eta}\,(C_D)$$

$$= \frac{479\,(3939)\,24}{(55-22)\,(.55)}\,(0.65)$$

= 1.6 MBTU SAVED / WINDOW / YR.

COSTS

MATERIALS:

HALF 4'×8' SHEET 1/2" PLYWOOD	$5.65
4'×4' RIGID POLYSTYRENE BOARD	+ 2.91
PAINT - PRIMER AND 1 COAT	+ 0.86
TOTAL COSTS	9.42

LABOR:

CUT AND FIT	3.22
FABRICATION AND PAINTING	3.98
INSTALLATION	(INCLUDED ABOVE)
	7.20

TOTAL COST = $16.62 PER WINDOW

BI-ANNUAL COST (PAINTING) = $3.42 PER WINDOW ($1.71 /YR.)

. NOTE: COSTS DERIVED FROM 1982 BUILDING CONSTRUCTION COST DATA GUIDE.

FM068.0881/0108

REPLACEMENT OF OVERHEAD DOORS: ENERGY SAVINGS AND ECONOMIC CALCULATIONS

LIFE CYCLE COST ANALYSIS SUMMARY
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)

LOCATION: Fort A.P. Hill, Virginia REGION: 3 PROJECT NO.: DACA 31-89-C-0198
PROJECT TITLE: Fort A.P. Hill- Energy Engineering Analysis Program FISCAL YEAR: 1994
DISCRETE PORTION NAME: Replace Overhead Doors (as need basis)
ANALYSIS DATE: January 1994 ECONOMIC LIFE (YRS) 20 PREPARER: JJS

1. INVESTMENT COSTS:

A. CONSTRUCTION COST	$	3,950
B. SIOH	$	217
C. DESIGN COST	$	237
D. TOTAL COST (1A+1B+1C)	$	4,404
E. SALVAGE VALUE OF EXISTING EQUIPMENT		
F. PUBLIC UTILITY COMPANY REBATE		
G. TOTAL INVESTMENT (1D-1E-1F)		$4,404

2. ENERGY SAVINGS (+)/COST(-):

DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS- Oct 1992

ENERGY SOURCE	COST $/MBTU(1)	SAVING(S) MBTU/YR(2)	ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELEC	$20.67		$		$
B. DIST	$5.69	122.0	$ 694	17.70	$ 12,287
C. RESID			$		$
D. NG			$		$
E. LPG	$7.76		$		$
F. COAL			$		$
G. SOLAR			$		$
H. GEOTH			$		$
I. BIOMA			$		$
J. REFUS			$		$
K. WIND			$		$
L. OTHER			$		$
M. DEMAND SAVINGS			$		$
N. TOTAL		122	$ 694		$ 12,287

3. NON ENERGY SAVINGS (+) OR COST (-):

A. ANNUAL RECURRING (+/-)
(1) DISCOUNT FACTOR (TABLE A)
(2) DISCOUNTED SAVINGS/COST (3A X 3A1)

B. NON RECURRING SAVINGS (+) OR COST (-)

ITEM	SAVINGS(+) COST(-)(1)	YEAR OF OCCUR. (2)	DISCOUNT FACTOR(3)	DISCOUNTED SAV-INGS(+)COST(-)(4)
a.	$			$
b.	$			$
c.	$			$
d. TOTAL				$

C. TOTAL NON ENERGY DISCOUNTED SAVINGS (3A2+3Bd4)

4. SIMPLE PAYBACK 1G/(2N3+3A+(3Bd1/ECONOMIC LIFE)):	6.34 YEARS
5. TOTAL NET DISCOUNTED SAVINGS (2N5+3C):	$12,287
6. SAVINGS TO INVESTMENT RATION (SIR) 5/1G:	2.79
7. ADJUSTED INTERNAL RATE OF RETURN (AIRR):	5.47%

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EAC STANDARD FORM
JULY 1985

ENGINEERING ANALYSIS

Sheet 1 of 1

By: JS

Project: ESOS FORT AP HILL   Date: 12/7/92

Contract No.: ____   EAC Project No.: 92008

* INSTALLED COST of AUTOMATIC INSULATED OVERHEAD ROLLING DOOR (R=6) = $3,950 (15' x 12')

COST PER FT² = $21.94

[JS ARCHER COMPANY, RICHMOND, VA
CORNWELL INSULATED ROLLING OVERHEAD DOOR
MODEL: INSULATED SLAT #6F.]

* COST INCLUDES REMOVAL OF EXISTING DOOR

PROJECT NAME: FORT HILL EEAP	PROJECT PART: OVERHEAD DOORS	SPEC. DIVISION: INCREMENT "F"
DEPARTMENT: MECHANICAL	COMPUTED BY: BJC DATE: 9-1-82	JOB NO: 4417.01
SHEET NO: OF:	CHECKED BY: DATE:	SHEET NO: 1 OF: 2

OVERHEAD DOOR REPLACEMENT

THIS PROJECT RECOMMENDS THE REPLACEMENT OF EXISTING, UNINSULATED, NON-WEATHERSTRIPPED OVERHEAD DOORS WITH NEW TIGHT FITTING, INSULATED DOORS. DUE TO THE HIGH COST OF THE REPLACEMENT DOOR, THIS PROJECT WILL BE STUDIED ON A PER DOOR BASIS. IT IS RECOMMENDED THAT THESE DOORS BE INSTALLED WHEN EXISTING DOORS BECOME DAMAGED AND ARE SCHEDU FOR REPLACEMENT.

CALCULATIONS

INFILTRATION: THE POOR FIT OF EXISTING OVERHEAD DOORS, PERMITS A LARGE AMOUNT OF OUTSIDE AIR TO INFILTRATE INTO THE BUILDING. IN SOME CASES SPACES AS LARGE AS ONE INCH CAN BE FOUND BETWEEN DOOR AND DOOR FRAME.

FOR AN AVERAGE 1/4 IN. CRACK BETWEEN DOOR AND FRAME, AND AN AVERAGE PRESSURE DIFFERENTIAL OF 0.1 "W.C. (15 MPH WINDSPEED) THE INFILTRATION RATE IS APPROXIMATELY 25 CFM / LINEAR FT. OF CRACK.
FOR AN EXISTING 12'×12' DOOR, INFILTRATION IS APPROXIMATELY 48'×25 = 1200 CFM / DOOR *

FOR A NEW WEATHERSTRIPPED DOOR, THE CRACK BETWEEN DOOR AND FRAME IS ABOUT 1/8 IN. OR LESS. INFILTRATION IS ABOUT 5 CFM / LINEAR FOOT OR 5×48' = 240 CFM / DOOR

REDUCTION IN INFILTRATION = 1200 − 240 = 960 CFM

HEAT LOSS REDUCTION = CFM × 1.08 × ΔT

= 960 × 1.08 × (55 − 22)

ΔQ = 34214 BTUH SAVED / DOOR

* BASED ON 1981 ASHRAE GUIDE CH.23.12; 23.13 FOR SWINGING DOORS.

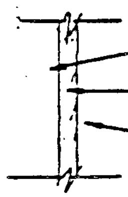
DESIGN ANALYSIS

☐ BUDGET
☐ PRELIMINARY
☐ FINAL
☐ OTHER

PROJECT NAME: FORT HILL GEAP	PROJECT PART: OVERHEAD DOORS	SPEC. DIVISION: "F"
DEPARTMENT: MECHANICAL	COMPUTED BY: BJC DATE: 9-1-82	JOB NO: 4417.01
SHEET NO: OF:	CHECKED BY: DATE:	SHEET NO: 2 OF: 2

TRANSMISSION: THE EXISTING DOORS ARE MADE OF 3/4" PINE WITH NO INSULATION. HEAT TRANSMISSION THROUGH THE DOOR WILL BE GREATLY REDUCED WITH THE INSTALLATION OF INSULATED DOORS

"U" VALUE (EXISTING DOOR)



	"R" VALUE
INSIDE AIR FILM	0.68
3/4" PINE	0.94
OUTSIDE AIR FILM	0.17
	$R_T = 1.79$

$$U = 1/R_T = 1/1.79 = 0.56$$

"U" VALUE (PROPOSED DOOR)

U = 0.20 (MANUFACTURERS DATA - ATLAS THERMAL D[illegible])

HEAT LOSS REDUCTION $(\Delta Q) = \Delta U \cdot A \cdot \Delta T$

$= (.56 - .2)(144)(55 - 22)$

$\Delta Q = 1711$ BTUH / DOOR

TOTAL REDUCTION IN HEAT LOSS = 1711 + 34214

= 35925 BTUH SAVED / DOOR

ANNUAL ENERGY SAVINGS (MODIFIED DEGREE DAY METHOD)

$$E = \frac{H_L (D) 24}{\Delta T (\eta)} (C_D) = \frac{35925 (3939) 24}{(55-22) .55} (.65)$$

= 122 MBTU SAVED / YR PER DOOR.

INSULATION OF DOMESTIC WATER HEATERS: ENERGY SAVINGS AND ECONOMIC CALCULATIONS

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LIFE CYCLE COST ANALYSIS SUMMARY
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)

LOCATION: Fort A.P. Hill, Virginia REGION: 3 PROJECT NO.: DACA 31-89-C-0198
PROJECT TITLE: Fort A.P. Hill- Energy Engineering Analysis Program FISCAL YEAR: 1994
DISCRETE PORTION NAME: Water Heater Insulation
ANALYSIS DATE: January 1994 ECONOMIC LIFE (YRS) 20 PREPARER: JJS

1. INVESTMENT COSTS:

A. CONSTRUCTION COST	$	26,765	
B. SIOH	$	1,472	
C. DESIGN COST	$	1,606	
D. TOTAL COST (1A+1B+1C)	$	29,843	
E. SALVAGE VALUE OF EXISTING EQUIPMENT			
F. PUBLIC UTILITY COMPANY REBATE			
G. TOTAL INVESTMENT (1D-1E-1F)			$29,843

2. ENERGY SAVINGS (+)/COST(-):

DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS- Oct 1992

ENERGY SOURCE	COST $/MBTU(1)	SAVING(S) MBTU/YR(2)		ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)		DISCOUNTED SAVINGS(5)
A. ELEC	$20.67	175.6	$	3,629	14.65	$	53,165
B. DIST	$5.69	329.7	$	1,876	17.70	$	33,205
C. RESID			$			$	
D. NG			$			$	
E. LPG	$7.76		$			$	
F. COAL			$			$	
G. SOLAR			$			$	
H. GEOTH			$			$	
I. BIOMA			$			$	
J. REFUS			$			$	
K. WIND			$			$	
L. OTHER			$			$	
M. DEMAND SAVINGS			$			$	
N. TOTAL		505	$	5,505		$	86,370

3. NON ENERGY SAVINGS (+) OR COST (-):

A. ANNUAL RECURRING (+/-)
(1) DISCOUNT FACTOR (TABLE A)
(2) DISCOUNTED SAVINGS/COST (3A X 3A1)

B. NON RECURRING SAVINGS (+) OR COST (-)

ITEM		SAVINGS(+) COST(-)(1)	YEAR OF OCCUR. (2)	DISCOUNT FACTOR(3)		DISCOUNTED SAVINGS(+)COST(-)(4)
a.	$				$	
b.	$				$	
c.	$				$	
d. TOTAL					$	

C. TOTAL NON ENERGY DISCOUNTED SAVINGS (3A2+3Bd4)

4. SIMPLE PAYBACK 1G/(2N3+3A+(3Bd1/ECONOMIC LIFE)):	5.42 YEARS
5. TOTAL NET DISCOUNTED SAVINGS (2N5+3C):	$86,370
6. SAVINGS TO INVESTMENT RATION (SIR) 5/1G:	2.89
7. ADJUSTED INTERNAL RATE OF RETURN (AIRR):	5.68%

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CONSTRUCTION COST ESTIMATE	Date Prepared: 1/27/94	Reference: Means
Activity and Location: Energy Savings Opportunity Survey Fort A. P. Hill, Virginia	Constr. Contact No. DACA 31-89-C-0198	I.D. No.
	Estimated By: EAC, P.C.	Category Code
Project: Hot water heater insulation- Electric Tanks	Status: Final	Job Order No.

ITEM DESCRIPTION	QUANTITY		PRIME CONTRACTOR				SUBCONTRACTOR				TOTAL COST
			MATERIAL COST		LABOR COST		MATERIAL COST		LABOR COST		
	NUMBER	UNIT	UNIT COST	TOTAL	UNIT COST	TOTAL	UNIT COST	TOTAL	UNIT COST	TOTAL	
Insulation wrap kit- 1-1/2" thickness (20-80 Gallon)	150	EA	25.00	3,750	18.00	2,700					6,450
SUBTOTAL				$3,750		$2,700					$6,450

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CONSTRUCTION COST ESTIMATE	Date Prepared: 1/27/94	
Activity and Location: Energy Savings Opportunity Survey Fort A. P. Hill, Virginia	Constr. Contact No. DACA 31-89-C-0198	I.D. No.
	Estimated By: EAC, P.C.	Category Code
Project: Hot water heater insulation- Electric Tanks	Status: Final	Job Order No.

ITEM DESCRIPTION	QUANTITY		PRIME CONTRACTOR				SUBCONTRACTOR				TOTAL COST
			MATERIAL COST		LABOR COST		MATERIAL COST		LABOR COST		
SUMMARY	NUMBER	UNIT	UNIT COST	TOTAL	UNIT COST	TOTAL	UNIT COST	TOTAL	UNIT COST	TOTAL	
Subtotal				3,750		2,700					
DIRECT COSTS				3,750		2,700					
Design contingency			10.0%	375	10.0%	270	10.0%				
SUBTOTAL (DIRECT COSTS)				4,125		2,970					
Material Tax & Labor Taxes			5.0%	206	21.0%	624	5.0%		21.0%		
Overhead			15.0%	619	15.0%	446	15.0%		15.0%		
SUBTOTAL				4,950		4,039					
Profit			12.0%	594	12.0%	485	12.0%		12.0%		
SUBTOTAL				5,544		4,524					
Prime Overhead on Sub							5.0%		5.0%		
SUBTOTAL											
Prime Profit on Sub							5.0%		5.0%		
TOTAL				5,544		4,524					10,068

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CONSTRUCTION COST ESTIMATE	Date Prepared: 1/27/94	Reference: MMM Design 1982/ 1992 R.S. Means
Activity and Location: Energy Savings Opportunity Survey Fort A. P. Hill, Virginia	Constr. Contact No. DACA 31-89-C-0198	I.D. No.
	Estimated By: EAC, P.C.	Category Code
Project: Hot water heater insulation- Oil Fired	Status: Final	Job Order No.

ITEM DESCRIPTION	QUANTITY		PRIME CONTRACTOR				SUBCONTRACTOR				TOTAL COST
			MATERIAL COST		LABOR COST		MATERIAL COST		LABOR COST		
	NUMBER	UNIT	UNIT COST	TOTAL	UNIT COST	TOTAL	UNIT COST	TOTAL	UNIT COST	TOTAL	
Add 3" Tank Fiberglass to DHW (FRK 3" Thick, .75lb Density)	5,678	SF	0.59	3,350	1.41	8,006					11,356
SUBTOTAL				$3,350		$8,006					$11,356

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CONSTRUCTION COST ESTIMATE	Date Prepared: 1/27/94	
Activity and Location: Energy Savings Opportunity Survey Fort A. P. Hill, Virginia	Constr. Contact No. DACA 31-89-C-0198	I.D. No.
	Estimated By: EAC, P.C.	Category Code
Project: Hot water heater insulation- Oil Fired	Status: Final	Job Order No.

ITEM DESCRIPTION	QUANTITY		PRIME CONTRACTOR				SUBCONTRACTOR				TOTAL COST
			MATERIAL COST		LABOR COST		MATERIAL COST		LABOR COST		
SUMMARY	NUMBER	UNIT	UNIT COST	TOTAL	UNIT COST	TOTAL	UNIT COST	TOTAL	UNIT COST	TOTAL	
Subtotal				3,350		8,006					
DIRECT COSTS				3,350		8,006					
SUBTOTAL (DIRECT COSTS)				3,350		8,006					
Material Tax & Labor Taxes			5.0%	168	21.0%	1,681	5.0%		21.0%		
Overhead			15.0%	503	15.0%	1,201	15.0%		15.0%		
SUBTOTAL				4,020		10,888					
Profit			12.0%	482	12.0%	1,307	12.0%		12.0%		
SUBTOTAL				4,502		12,195					
Prime Overhead on Sub							5.0%		5.0%		
SUBTOTAL											
Prime Profit on Sub							5.0%		5.0%		
TOTAL COST				4,502		12,195					$16,697

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Water Heater Insulating Kits- Electric

Existing Conditions		Add Insulation Kits
		4 Additional R Value
Heater Eff.=	100%	100%
Tank Capacity	40 Gallons	40 Gallons
Utank=	0.22 Btu/F*Ft**2*Hr	0.11702 Btu/F*Ft**2*Hr
Atank=	27 Ft**2	30 Ft**2
Ttank=	120 F	120 F
Tsurroundings=	65 F	65 F
Operational Hours	8760	8760
Part Time Load	4392	4392

Year Round Savings

Existing Energy Usage	2,861,892.00	Btu/Yr
New Energy Usage w/Insulation	(1,691,425.53)	Btu/Yr
Savings	1.17	Mbtu/Yr
$ Savings	24	

Seasonal Savings (April-October)

Existing Energy Usage	1,434,866.40	Btu/Yr
New Energy Usage w/Insulation	(848,029.79)	Btu/Yr
Savings	0.59	Mbtu/Yr
$ Savings	12	

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		MBtu/Yr	$/Yr
Number of Tanks	150	175.57	3,629

		Materials	Labor
Per Tank		25	18
Number of Tanks	150	3,750	2,700

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A Professional
Corporation

9004-B Crownwood Ct.
Burke, Virginia 22015-1630
(703) 978-0923

ENGINEERING ANALYSIS

Sheet ____ of ____

By: ____

Water Heater Insulation Kits

Project: Fort A. P. Hill ESOS   Date: 2-28-94

Contract No.: DACA 31-89-C-0198   EAC Project No.: 92008

Number of oil Fired tanks taken from building system printout list
Buildings with oil fired boilers were assumed to have oil fired
Hot water storage tanks for subgroups - Quarters and Dinning as well
as large (500 man) latrines.

# of electric water heaters -
subtract oil fired heaters from total group square feet of
floor area.

Housing - $476,974 - 348,541 = 128\,433\ Ft^2$

$128,433\ Ft^2 \times \frac{1\ TANK}{1500\ Ft^2} = 107$ TANKS (ELECTRIC)

Admin - $214,966 \times \frac{1\ TANK}{5000\ Ft^2} = 42$ TANKS

Total Electric Fired Hot Water Heaters $= 107 + 42 = 149$
$\cong 150$ TANKS

BUILDING USE-GROUP	SUB-GROUP NO.	STUDY BUILDING NO.	WALL CODE	ROOF CODE	EN. SYS. CODE	TOTAL SUB-GROUP SQUARE FEET	TOTAL USE-GROUP SQUARE FEET
Administration	A-1	101/126/214	WD	PS	AB	138,136	
	A-2	none	VARIES	VARIES	B	76,830	214,966
Quarters	B-1	179/311	WD	PS	AB	127,281	
	B-2	1528	MAS	PS	AB	38,967	
	B-3	none	Varies	Varies	B	310,726	476,974
Shops	C-1	313	WD	PS	AB	38,394	
	C-2	1290	MAS	BU	AB	87,503	
	C-3	none	varies	varies	B	34,690	185,380
Latrines	E-1	821	MAS	BU	AB	19,573	
	E-2	none	varies	varies	B	13,961	33,534
Nonenergized	F-1	none	varies	varies	O	149,038	149,038
TOTAL BUILDING AREA							1,149,027

Wall Construction Code:

WD - Wood or metal frame with wook siding, metal siding or brick veneer.
MAS - Masonry block or brick.

Roof Construction Code:

PS - Pitched shingle over wood deck or metal roofing.
BU - Built-up roof over wood or metal deck.

Energized systems Code:

AB - Heating and non-heating systems.
B - Non-heating systems only.
O - No energized systems.

FORT A.P. HILL BUILDING USE-GROUP SUMMARY
FIGURE 1

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712

tudy Building- 179
Floor Area 11,980 Ft**2

ECO	ECO Savings		Average Study Blg Savings		Average Study Blg Cost		Average Group Savings		Average Group Cost		No. of Units Per Study Bldg	Units per Study Blg Floor Area	Total Units Per Group
Study Blg 179	MBtu/Yr	$/Yr	MBtu/ft**2	$/Yr/ft**2	Materials $/ft**2	Labor $/ft**2	MBtu/Yr	$/Yr	Materials $	Labor $			
Insulate Water Tanks Seasonal Savings	8.47	48	0.0007	0.0040	0.008264	0.019616	246.4	1,401.8	2,880	6,837	1	8.35E-05	29

ECO	ECO Savings		Average Study Blg Savings		Average Study Blg Cost		Average Group Savings		Average Group Cost		No. of Units Per Study Bldg	Units per Study Blg Floor Area	Total Units Per Group
Study Blg 179	MBtu/Yr	$/Yr	MBtu/ft**2	$/Yr/ft**2	Materials $/ft**2	Labor $/ft**2	MBtu/Yr	$/Yr	Materials $	Labor $			
Insulate Water Tanks Year Round Savings	16.89	96	0.0014	0.0080	0.008264	0.019616	83.3	474.0	488	1,159	1	8.35E-05	5

Water Heater Insulating Kits- Oil Fired

Existing Conditions		Add Insulation Kits
		11 R-Value
Heater Eff.=	70%	70%
Tank Capacity	750 Gallons	750 Gallons
Utank=	0.15 Btu/F*Ft**2*Hr	0.0566 Btu/F*Ft**2*Hr
Atank=	138 Ft**2	167 Ft**2
Ttank=	180 F	180 F
Tsurroundings=	60 F	60 F
Operational Hours	8760	8760
Part Time Load	4392	4392

	Year Round Savings		
Existing Energy Usage		31,085,485.71	Btu/Yr
New Energy Usage w/Insulation		(14,195,450.13)	Btu/Yr
	Savings	16.89	Mbtu/Yr
	$ Savings	96	
	Seasonal Savings (April-October)		
Existing Energy Usage		15,585,325.71	Btu/Yr
New Energy Usage w/Insulation		(7,117,170.89)	Btu/Yr
	Savings	8.47	Mbtu/Yr
	$ Savings	48	

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Subgroup B-2- Seasonal Use Buildings	
1526	7,563
1528	7,563
1529	7,563
1532	7,563
1533	7,563
	37,815
Subgroup B-3-Seasonal Use Buildings	
1635	3,441
1636	3,441
1637	9,633
1638	9,633
1639	9,633
1640	9,633
1642	9,633
1643	9,633
1644	9,633
1645	9,633
1646	9,633
1647	9,633
1648	9,633
1649	3,441
1651	3,441
1652	9,633
1653	9,633
1655	3,441
1657	9,633
1658	9,633
1662	9,633
1663	9,633
1666	9,633
1667	9,633
1668	9,633
1669	9,633
1671	3,441
1680	3,441
1681	3,441
1682	3,441
1688	9,683
1689	9,683
1691	9,683
1692	9,683
1693	9,683
1695	9,683
1696	9,683
1694	9,683
	310,726
Subgroup D-2 Year Round Use	
820	6,176
1525	12,000
	18,176
Subgroup D-3 Year Round Use	
1641	11,070
1659	11,070
1690	11,070
	33,210
Subgroup E-1 Year Round Use	
305	1,250
306	1,250
506	720
530	1,000
1320	1,240
1521	240
1522	1,000
1622	1,000
	7,700

BASED ON THE STUDY BUILDING GROUP, ADMINISTRATIVE & SHOP BUILDINGS HAVE SMALL ELECTRIC WATER HEATERS, HOWEVER, SOME HEATERS ARE DE-ACTIVATED AND ADDITIONAL SHUT-DOWNS ARE RECOMMENDED.

TYP. 40 GAL. TANK, VERTICAL
APPROX. 18"ϕ x 5' HIGH $5 \times \pi \times (18-4)^2 \times 7.48 / 4 \times 144 = 40$ ✓
SURFACE AREA $= (\pi \times 18^2 / 4 \times 144) + (\pi \times 18 \times 5/12) = 25$ FT²
$R_1 \approx 4$
$U_1 = 1/(4+.68) = 0.21$ BTU/HR-FT²-F

ADD INSULATION KIT, 1½" TK. FIBERGLASS
AREA $= (\pi \times 21^2 / 4 \times 144) + (\pi \times 21 \times 5.1/12) = 30$ FT²
$U_2 = 1/(4+4+.68) = 0.11$

$\Delta U \times A \approx U_1 \times A_1 - U_2 \times A_2$ (NEGLECT CURVATURE)
$= (0.21 \times 25) - (0.11 \times 30) = 2.0$ BTU/HR-°F

YEAR-ROUND SAVINGS

TANK TEMP. = 120°F
AVG. OUTDOOR AIR TEMP. = 58°F, USE 60°F
SAVINGS $= (\Delta U \times A) \times \Delta T \times$ HRS
$= 2.0 \times (120-60) \times 365 \times 24 \times 11600/3413 = 3.6$ MBTU
E/C = 3.6 / (56.9/1000) = 62.8 ✓
PAYBACK = 2.2 YRS

SEASONAL SAVINGS, APRIL → OCT

AVG. OUTDOOR AIR TEMP. ≈ 61°F, USE 63°F
SAVINGS $= 2.0 \times (120-63) \times 183 \times 24 \times 11600/3413 = 1.7$ MBTU
E/C = 1.7 / (56.9/1000) = 29.9 ✓
PAY-BACK = 4.6 YRS

NOTE - LIFE CYCLE BENEFITS ARE DEPENDENT UPON REMAINING SERVICE LIFE OF WATER HEATER

MMM DESIGN GROUP
A PROFESSIONAL CORPORATION
ARCHITECTS+ENGINEERS+PLANNERS

DESIGN ANALYSIS

☐ BUDGET
☐ PRELIMINARY
☐ FINAL
☐ OTHER ______

PROJECT NAME: EEAP - A P HILL	PROJECT PART: WATER HEATER INSULATION	SPEC. DIVISION: 750 GAL. OIL
DEPARTMENT: MECHANICAL	COMPUTED BY: CTW DATE: 3/14/83	JOB NO: 4417.02
SHEET NO: OF:	CHECKED BY: DATE:	SHEET NO: OF:

BASED ON STUDY BUILDINGS, OTHER BUILDINGS HAVE LARGE, OIL-FIRED WATER HEATERS. A LARGE PORTION OF THE BARRACKS HAVE NO DOMESTIC HOT WATER OR HAVE SMALL HEATERS, SINCE THEY ARE SERVICED BY CENTRAL LAVATORY FACILITIES. DINING FACILITIES REQUIRE HIGHER STORAGE TEMPERATURES FOR SANITARY DISHWASHING.

TYP. 750 GAL. STORAGE TANK, HORIZONTAL
APPROX. 5'ϕ x 6.3' LONG $\pi \times (5-0.5)^2 \times 6.3 \times 7.48/4 = 750$ ✓
$A_1 = (\pi \times 5^2/2) + (\pi \times 5 \times 6.3) = 138\ FT^2$
$R \approx 6$
$U_1 = 1/(6+.68) = 0.150$

ADD INSULATION, 3" TK. FIBERGLASS W/ VINYL JACKET (R-11)
$A_2 = (\pi \times 5.5^2/2) + (\pi \times 5.5 \times 6.9) = 167\ FT^2$
$U_2 = 1/(6+11+.68) = 0.057$

$\Delta U \times A = U_1 \times A_1 - U_2 \times A_2$ (NEGLECT CURVATURE)
$= 0.150 \times 138 - 0.057 \times 167 = 11.2$ BTU/HR·F

SAVINGS = $\Delta U \times A \times \Delta T \times HRS \times 1/0.70$ (EFFICIENCY)

TANK TEMP	ITEM	YEAR-ROUND 8760 HRS	SEASONAL 4392 HRS
120°F	ΔT =	60	63
	MBT SAVED =	8.4	4.4
	E/C =	20.4 ✓	10.7
	PAY-BACK, YRS =	2.9	5.6
180°F	ΔT =	120	123
	MBTU SAVED =	16.8	8.6
	E/C =	40.7 ✓	20.9 ✓
	PAY-BACK, YRS =	1.5	2.8

NOTE - LIFE CYCLE BENEFITS ARE DEPENDENT UPON REMAINING SERVICE LIFE OF WATER HEATER.

FM/005 .1/0108

Building 172- Computer Simulation Input Data

BUILDING DESCRIPTION

Building : #172 AP Hill-Comm. Club — 03-14-94
Prepared By: E.A.C., P.C. Burke, VA — 6063092204
Carrier Hourly Analysis Program —

****

1. BUILDING INPUTS

BUILDING NAME = #172 AP Hill-Comm. Club

MISCELLANEOUS ELECTRIC

Maximum power	=	0.0 kW
Power schedule	=	1

DOMESTIC WATER HEATING

Is a domestic how water system used	?	Y
Maximum hourly hot water use	=	50.0 gal
Hot water schedule	=	3
Average entering water temperature	=	50.0 F
Average hot water supply temperature	=	120.0 F
Heating plant type	=	1 : Electric

OTHER INPUTS

Additional building floor area	=	0.0 sqft
Electrical generating efficiency	=	100.00 %

****

2. PLANT SELECTION

Plant Name	Mult	Plant Name	Mult
BASEMENT	1	FIRST FLOOR	1
FOOD PREPARATION	1	BALCONY	1

****

3. FUEL & ELECTRIC RATE SELECTION

Fuel or Energy	No.	Name of Rate Schedule	Currency
Electric	1	RAPPAHANNOCK	$
Natural Gas	1	LPG	$
Fuel Oil	1	LPG	$
Propane	1	LPG	$
Remote Source Heating	1	LPG	$
Remote Source Cooling	1	LPG	$

****

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EAC STANDARD FORM
August 1985

Contract No. DACA-31-89-C-0198

HEAT GAIN AND LOSS CALCULATIONS

Preliminary Selection
Final Selection

Project Name: FORT A.P HILL ESOS

EAC Project Number: 92008 Date MARCH 94 By: JS

Location: FORT A P HILL

North Altitude 38.1 Design Month ______

Building Construction:

☐ Light
☐ Medium
☐ Heavy

Thermal Load Averaging Hours ______

Design Conditions

	Summer		Winter
Outside:	DB 93 F	WB 76 F	DB 14 F
Inside:	DB 78 F	WB ___ F	DB 70 F

U-Factors

Roof .093,
Floor .0816
Wall .0695, (.148 Basement)
Partition .725
Door Solid wood - .33
Glass (Shading)
Glass (No Shading) .57 (1" insulated)
Shading Coefficient
For Glass ______ (Shading) ______ (No Shading)

Lighting Level ______

Occupancy ______

General Remarks ELEV - 164 Ft

Engineering
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EAC STANDARD FORM
July 1985

SHEET NO. 1

U-VALUE CALCULATION FORM

FOR WALL/PARTITION

Project: Fort AP Hill, Virginia

EAC Project Number: 92003 Date: 12-7-92 By: JC

☒ Wall ☐ Partition

	Material	Resistance ($h\text{-}ft^2$ - F/Btu) Summer	Winter
1.	Outside Air	0.25	0.17
2.	Inside Still Air	0.68	0.68
3.	6" Pine Logs	6.0	
4.	1.5" Fiberglass Batt Insul.	7.0	
5.	1/2" Drywall	.45	
6.			
7.			
8.			
	Total (R) =	14.38	
	U = 1/R =	.0695	

(Btu/h-sq.ft. - F)

MATERIAL	R*	MATERIAL	R*
Air Space 3/4" (90 F)	0.84	Blanket/Batt Insul.	
Air Space 3/4" (0 F)	1.18	2-2 3/4 in.	7.00
Still Air	0.68	3-4 in.	11.00
Moving Air 7 1/2 MPH	0.25	3.5 in	13.00
Moving Air 15 MPH	0.17	5.5-6.5 in.	19.00
Face Brick 4"	0.44	6-7.5 in.	22.00
Cinderblock 4"	1.11	9-10 in.	30.00
Cinderblock 8"	1.72	12-13 in.	38.00
Cinderblock 12"	1.89	Rigid Insul. 1"	2.78
Gypsum Bd 3/8"	0.32	Stryofoam 1"	4.00
Gypsum Bd 1/2"	0.45	Vermiculite 1"	2.27
Gypsum Plaster 1/2"	0.45	Vapor Barr.-felt	0.06
Sand Plaster 3/8"	0.08	Fir, Pine & Simil. Woods 3/4"	0.94
Loose Fill Sandust 1"	2.22		
Perlite Expanded 1"	2.90		

*(h-sq.ft. - F/Btu)

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EAC STANDARD FORM
July 1985

SHEET NO. 2

U-VALUE CALCULATION FORM

FOR ROOF/FLOOR

Project: ESDS FORT A.P. HILL, VIRGINIA

EAC Project Number: 92003 Date: 12-7-92 By: JS

☒ Roof ☐ Floor

	Material	Resistance (h-sq. ft.-F/Btu) Summer	Winter
1.	Top Surface (Moving Air)	0.25	0.17
2.	Bottom Surface (Still Air)		
3.	MINERAL FIBER SHINGLES	.44	
4.	ROOFING FELT	.15	
5.	2.5" RIGID INSULATION	6.95	
6.	3" T & G WOOD DECK	3.0	
7.			
8.			
	Total (R) =	10.79	
	U = 1/R =	.093	

(Btu/h-sq.ft. - F)

MATERIAL	DIRECTION OF HEAT FLOW	R*
Air Space 3/4" (0 F)	UP	0.93
Air Space 4"	UP	1.03
Air Space 3/4" (90 F)	DN	0.85
Air Space 4"	DN	1.00
Still Air	UP	0.61
Still Air	DN	0.92
Moving Air 7 1/2 MPH	ANY	0.25
Moving Air 15 MPH	ANY	0.17
Acoustical Tile 1/2"		1.25
Acoustical Tile 3/4"		1.89
Sand Plaster 3/8"		0.08
Gypsum Plaster 1/2"		0.45

MATERIAL	R*
Batt/Blanket	
2-2 3/4 in.	7.00
3-4in.	11.00
3.5 in.	13.00
5.5-6.5 in.	19.00
6-7.5 in.	22.00
9-10 in.	30.00
12-13 in.	38.00
Rigid Insul. 1"	2.78
Stryofoam 1"	4.00
Built-up Roof 3/8"	0.33
Asphalt Shingles	0.44

*(h-sq.ft. - F/Btu)

Engineering
Applications
Consultants

EAC STANDARD FORM
July 1985

SHEET NO. 3

U-VALUE CALCULATION FORM

FOR ROOF/FLOOR

Project: ESDS, Fort A.P. Hill, VA

EAC Project Number: 92008 Date: 12-7-92 By: JS

☐ Roof ☒ Floor

	Material	Resistance (h-sq. ft.-F/Btu) Summer	Winter
1.	Top Surface (Moving Air)	0.25	0.17
2.	Bottom Surface (Still Air)		
3.	Vinyl Asbestos Tile	NEGLI.	
4.	6" Concrete	12	
5.			
6.			
7.			
8.			
	Total (R) =	12.25	
	U = 1/R =	.0816	

(Btu/h-sq.ft. - F)

MATERIAL	DIRECTION OF HEAT FLOW	R*
Air Space 3/4" (0 F)	UP	0.93
Air Space 4"	UP	1.03
Air Space 3/4" (90 F)	DN	0.85
Air Space 4"	DN	1.00
Still Air	UP	0.61
Still Air	DN	0.92
Moving Air 7 1/2 MPH	ANY	0.25
Moving Air 15 MPH	ANY	0.17
Acoustical Tile 1/2"		1.25
Acoustical Tile 3/4"		1.89
Sand Plaster 3/8"		0.08
Gypsum Plaster 1/2"		0.45

MATERIAL	R*
Batt/Blanket	
2-2 3/4 in.	7.00
3-4in.	11.00
3.5 in.	13.00
5.5-6.5 in.	19.00
6-7.5 in.	22.00
9-10 in.	30.00
12-13 in.	38.00
Rigid Insul. 1"	2.78
Stryofoam 1"	4.00
Built-up Roof 3/8"	0.33
Asphalt Shingles	0.44

*(h-sq.ft. - F/Btu)

Engineering
Applications
Consultants

EAC STANDARD FORM
July 1985

SHEET NO. 4

U-VALUE CALCULATION FORM

FOR WALL/PARTITION

Project: ESOS Fort A.P. Hill, Virginia

EAC Project Number: 92003 Date: 12-7-92 By: JS

☒ Wall ☐ Partition

Material		Resistance ($h\text{-}ft^2$ - F/Btu) Summer	Winter
1.	Outside Air	0.25	0.17
2.	Inside Still Air	0.68	0.68
3.	3/4" Rigid Insul	2.10	
4.	3" Block	.30	
5.	3" Block w/Insul	2.75	
6.	Inside Still Air	.68	
7.			
8.			
	Total (R) =	6.76	
	U = 1/R =	.148	

(Btu/h-sq.ft. - F)

MATERIAL	R*	MATERIAL	R*
Air Space 3/4" (90 F)	0.84	Blanket/Batt Insul.	
Air Space 3/4" (0 F)	1.18	2-2 3/4 in.	7.00
Still Air	0.68	3-4 in.	11.00
Moving Air 7 1/2 MPH	0.25	3.5 in	13.00
Moving Air 15 MPH	0.17	5.5-6.5 in.	19.00
Face Brick 4"	0.44	6-7.5 in.	22.00
Cinderblock 4"	1.11	9-10 in.	30.00
Cinderblock 8"	1.72	12-13 in.	38.00
Cinderblock 12"	1.89	Rigid Insul. 1"	2.78
Gypsum Bd 3/8"	0.32	Stryofoam 1"	4.00
Gypsum Bd 1/2"	0.45	Vermiculite 1"	2.27
Gypsum Plaster 1/2"	0.45	Vapor Barr.-felt	0.06
Sand Plaster 3/8"	0.08	Fir, Pine & Simil.	
Loose Fill Sandust 1"	2.22	Woods 3/4"	0.94
Perlite Expanded 1"	2.90		

*(h-sq.ft. - F/Btu)

Engineering
Applications
Consultants

EAC STANDARD FORM
July 1985

SHEET NO. 5

U-VALUE CALCULATION FORM
FOR WALL/PARTITION

Project: ESOC FORT AP HILL, VIRGINIA

EAC Project Number: 92 005 Date: 12-7-92 By: JS

☐ Wall ☒ Partition

	Material	Resistance ($h\text{-}ft^2$ - F/Btu) Summer	Winter
1.	Outside Air	0.25	0.17
2.	Inside Still Air	0.68	0.68
3.	1/2" Gyp Board	.45	
4.			
5.			
6.			
7.			
8.			
	Total (R) =	1.38	
	U = 1/R =	.725	

(Btu/h-sq.ft. - F)

MATERIAL	R*	MATERIAL	R*
Air Space 3/4" (90 F)	0.84	Blanket/Batt Insul.	
Air Space 3/4" (0 F)	1.18	2-2 3/4 in.	7.00
Still Air	0.68	3-4 in.	11.00
Moving Air 7 1/2 MPH	0.25	3.5 in	13.00
Moving Air 15 MPH	0.17	5.5-6.5 in.	19.00
Face Brick 4"	0.44	6-7.5 in.	22.00
Cinderblock 4"	1.11	9-10 in.	30.00
Cinderblock 8"	1.72	12-13 in.	38.00
Cinderblock 12"	1.89	Rigid Insul. 1"	2.78
Gypsum Bd 3/8"	0.32	Stryofoam 1"	4.00
Gypsum Bd 1/2"	0.45	Vermiculite 1"	2.27
Gypsum Plaster 1/2"	0.45	Vapor Barr.-felt	0.06
Sand Plaster 3/8"	0.08	Fir, Pine & Simil.	
Loose Fill Sandust 1"	2.22	Woods 3/4"	0.94
Perlite Expanded 1"	2.90		

*(h-sq.ft. - F/Btu)

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MASTER SCHEDULE SUMMARY

Prepared By : E.A.C., P.C. Burke, VA 03-01-94

Carrier Hourly Analysis Program 6063092204

****

MASTER SCHEDULE 1. OCCUPANCY Hourly Percentages

Hour ----->	0	1	2	3	4	5	6	7	8	9	10	11
Weekday	0	0	0	0	0	0	0	0	0	0	25	100
Saturday	0	0	0	0	0	0	0	0	0	0	25	100
Sunday	0	0	0	0	0	0	0	0	0	0	25	100
DESIGN	0	0	0	0	0	0	25	100	100	50	50	75

Hour ----->	12	13	14	15	16	17	18	19	20	21	22	23
Weekday	100	100	50	25	0	0	0	0	0	0	0	0
Saturday	100	100	50	25	100	100	100	100	0	0	0	0
Sunday	100	100	50	25	100	100	100	100	0	0	0	0
DESIGN	100	100	50	25	25	75	100	100	100	50	0	0

****

MASTER SCHEDULE 2. Lighting Hourly Percentages

Hour ----->	0	1	2	3	4	5	6	7	8	9	10	11
Weekday	5	5	5	5	5	5	5	5	5	5	25	100
Saturday	5	5	5	5	5	5	5	5	5	5	25	100
Sunday	5	5	5	5	5	5	5	5	5	5	25	100
DESIGN	5	5	5	5	5	5	25	100	100	50	50	75

Hour ----->	12	13	14	15	16	17	18	19	20	21	22	23
Weekday	100	100	100	100	5	5	5	5	5	5	5	5
Saturday	100	100	50	25	100	100	100	100	5	5	5	5
Sunday	100	100	50	25	100	100	100	100	5	5	5	5
DESIGN	100	100	50	25	25	75	100	100	100	50	5	5

****

MASTER SCHEDULE 3. Hot water Hourly Percentages

Hour ----->	0	1	2	3	4	5	6	7	8	9	10	11
Weekday	0	0	0	0	0	0	0	0	0	0	25	100
Saturday	0	0	0	0	0	0	0	0	0	0	25	100
Sunday	0	0	0	0	0	0	0	0	0	0	25	100
DESIGN	0	0	0	0	0	0	25	100	100	50	50	75

Hour ----->	12	13	14	15	16	17	18	19	20	21	22	23
Weekday	100	100	50	25	0	0	0	0	0	0	0	0
Saturday	100	100	50	25	100	100	100	100	0	0	0	0
Sunday	100	100	50	25	100	100	100	100	0	0	0	0
DESIGN	100	100	50	25	25	75	100	100	100	50	0	0

****

MASTER SCHEDULE 4. Dim Lights Hourly Percentages

Hour ----->	0	1	2	3	4	5	6	7	8	9	10	11
Weekday	5	5	5	5	5	5	5	5	5	5	25	80
Saturday	5	5	5	5	5	5	5	5	5	5	25	80
Sunday	5	5	5	5	5	5	5	5	5	5	25	80
DESIGN	5	5	5	5	5	5	25	100	100	50	50	75

Hour ----->	12	13	14	15	16	17	18	19	20	21	22	23
Weekday	50	50	50	75	5	5	5	5	5	5	5	5
Saturday	50	50	50	75	75	75	100	80	5	5	5	5
Sunday	50	50	50	75	75	75	100	80	5	5	5	5
DESIGN	100	100	50	25	25	75	100	100	100	50	5	5

MASTER SCHEDULE 5. Occupancy Sensors Hourly Percentages

Hour ----->	0	1	2	3	4	5	6	7	8	9	10	11
Weekday	0	0	0	0	0	0	0	0	0	0	25	90
Saturday	0	0	0	0	0	0	0	0	0	0	25	90
Sunday	0	0	0	0	0	0	0	0	0	0	25	90
DESIGN	0	0	0	0	0	0	25	100	100	50	50	75

Hour ----->	12	13	14	15	16	17	18	19	20	21	22	23
Weekday	100	100	50	25	0	0	0	0	0	0	0	0
Saturday	100	100	50	25	75	90	90	75	0	0	0	0
Sunday	100	100	50	25	75	90	90	75	0	0	0	0
DESIGN	100	100	50	25	25	75	100	100	100	50	0	0

MASTER SCHEDULE 6. Bathroom Occ. Sensors Hourly Percentages

Hour ----->	0	1	2	3	4	5	6	7	8	9	10	11
Weekday	0	0	0	0	0	0	0	0	0	0	5	25
Saturday	0	0	0	0	0	0	0	0	0	0	5	25
Sunday	0	0	0	0	0	0	0	0	0	0	5	25
DESIGN	0	0	0	0	0	0	25	100	100	50	50	75

Hour ----->	12	13	14	15	16	17	18	19	20	21	22	23
Weekday	60	60	20	10	0	0	0	0	0	0	0	0
Saturday	60	60	20	10	30	50	60	50	0	0	0	0
Sunday	60	60	20	10	30	50	60	50	0	0	0	0
DESIGN	100	100	50	25	25	75	100	100	100	50	0	0

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MASTER SCHEDULE 7. Dim Lights - Stairwell Hourly Percentages

Hour ----->	0	1	2	3	4	5	6	7	8	9	10	11
Weekday	5	5	5	5	5	5	5	5	5	5	50	50
Saturday	5	5	5	5	5	5	5	5	5	5	50	50
Sunday	5	5	5	5	5	5	5	5	5	5	50	50
DESIGN	5	5	5	5	5	5	25	100	100	50	50	75

Hour ----->	12	13	14	15	16	17	18	19	20	21	22	23
Weekday	60	50	50	50	5	5	5	5	5	5	5	5
Saturday	60	50	50	50	75	90	90	90	5	5	5	5
Sunday	60	50	50	50	75	90	90	90	5	5	5	5
DESIGN	100	100	50	25	25	75	100	100	100	50	5	5

MASTER SCHEDULE 8. Occ/Dimmer - Stairwell Hourly Percentages

Hour ----->	0	1	2	3	4	5	6	7	8	9	10	11
Weekday	0	0	0	0	0	0	0	0	0	0	25	50
Saturday	0	0	0	0	0	0	0	0	0	0	25	50
Sunday	0	0	0	0	0	0	0	0	0	0	25	50
DESIGN	0	0	0	0	0	0	25	90	90	50	50	75

Hour ----->	12	13	14	15	16	17	18	19	20	21	22	23
Weekday	60	50	50	25	0	0	0	0	0	0	0	0
Saturday	60	50	50	25	75	90	90	75	0	0	0	0
Sunday	60	50	50	25	75	90	90	75	0	0	0	0
DESIGN	60	50	50	25	25	90	90	75	75	50	0	0

PLANT DESCRIPTIONS

Plant : BASEMENT
Prepared By : E.A.C., P.C. Burke, VA
Carrier Hourly Analysis Program

03-14-94
6063092204

****

1 PLANT NAME AND TYPES

Class	= Heat Pumps
Name	= BASEMENT
Heat Pump Type	= Air Source Heat Pump
Auxiliary Plant Type	= Electrical Resistance

****

2 AIR SYSTEM SELECTION

Air System Name	Mult	Air System Name	Mult
HEAT PUMP- BASEMENT	1		

****

3 PLANT CHARACTERISTICS (Air Source Heat Pump)

COOLING DATA

Estimated maximum cooling coil load	= 3.59 Ton
Capacity at 95.0 F outdoor air	= 4.58 Ton
Input power rate at 95.0 F outdoor air	= 1.500 kW/Ton

HEATING DATA

Estimated maximum heating coil load	= 41.17 MBH
Capacity at 47.0 F outdoor air	= 41.5 MBH
Compressor, evaporator fan kW at 47.0 F outdoor air	= 4.6 kW
Outdoor air temperature for cutoff	= 0.0 F

AUXILIARY PLANT DATA

Plant type	= Electrical
Estimated maximum heating coil load	= 41.17 MBH
Type of heating	= Direct

****

4 PUMP SYSTEM DATA
(No inputs required)

****

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AIR SYSTEM DESCRIPTION

Name : HEAT PUMP- BASEMENT 03-14-94
Carrier Hourly Analysis Program 6063092204
Prepared By : E.A.C., P.C. Burke, VA

****

1. SYSTEM NAME AND TYPE
   - System Name = HEAT PUMP- BASEMENT
   - System Class = Constant Volume
   - System Type = (SZCV) Single Zone Constant Volume
   - Operation Type = 3 Cooling & Heating
   - Type of Heating = 1 Central Heating

****

2. SPACE SELECTION (see separate printout)

****

3. THERMOSTAT & EQUIPMENT SCHEDULING DATA

Operation Period	Thermostat Setpoints Cooling	Thermostat Setpoints Heating	Ventilation Dampers
Occupied	78.0 F	70.0 F	OPEN
Unoccupied	78.0 F	70.0 F	OPEN

Weekday	: Occupied Period Begins at	9	; Duration	=	7 hrs
Saturday	: Occupied Period Begins at	15	; Duration	=	5 hrs
Sunday	: Occupied Period Begins at	10	; Duration	=	0 hrs
Design Day	: Occupied Period Begins at	9	; Duration	=	8 hrs

****

4. SUPPLY, VENTILATION, RETURN AIR DATA

SUPPLY AIR
- Supply air flow rate = 2025.00 CFM
- Heating supply temperature = 100.0 F
- Fan operation for heating = 1 Continuous

VENTILATION AIR
- Nominal ventilation flow rate = 375.00 CFM
- Minimum ventilation flow rate = 0.00 CFM
- Damper leak rate = 5 % of vent air

RETURN AIR
- Zone exhaust air flow rate = 350.00 CFM
- Zone exhaust fan power = 0.8 kW
- Is a return plenum used ? N

****

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AIR SYSTEM DESCRIPTION

****

5. FAN DATA

SUPPLY FAN

Type	=	2:Forward curved
Static	=	2.00 in wg
Efficiency	=	54 %
Configuration	=	1 Draw-thru

RETURN FAN

Type	=	1:(Fan does not exist)

****

6. ACCESSORY DEVICES AND SYSTEMS

PREHEAT COIL
(Not used)

OUTDOOR AIR ECONOMIZER CONTROL
(Not used)

VENTILATION AIR RECLAIM
(Not used)

HUMIDITY CONTROL
(Not used)

****

7. MISCELLANEOUS SYSTEM DATA

Cooling coil bypass factor	=	0.050
Type of supplemental heating	=	2 Skin Heating Units

SKIN HEATING UNITS

Heat source	=	1 Baseboard Heaters
Skin heating trip temperature	=	55.0 F

****

AIR SYSTEM SPACE LIST

Name : HEAT PUMP- BASEMENT 03-14-94
Carrier Hourly Analysis Program 6063092204
Prepared By : E.A.C., P.C. Burke, VA Page 1

Space Name	Qty.	Space Name	Qty.
TABLE 1. SPACES IN ZONE 1			
7 CASUAL/BAR AREA BSMT	x 1	9 LADIES BSMT	x 1
8 MENS BSMT	x 1	10 CORRIDOR BSMT	x 1

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PLANT DESCRIPTIONS

Plant : FIRST FLOOR — 03-14-94

Prepared By : E.A.C., P.C. Burke, VA — 6063092204

Carrier Hourly Analysis Program —

****

1 PLANT NAME AND TYPES

Class	= Heat Pumps
Name	= FIRST FLOOR
Heat Pump Type	= Air Source Heat Pump
Auxiliary Plant Type	= Electrical Resistance

****

2 AIR SYSTEM SELECTION

Air System Name	Mult	Air System Name	Mult
FIRST FLOOR	1		

****

3 PLANT CHARACTERISTICS (Air Source Heat Pump)

COOLING DATA

Estimated maximum cooling coil load	= 4.31 Ton
Capacity at 95.0 F outdoor air	= 5.73 Ton
Input power rate at 95.0 F outdoor air	= 1.500 kW/Ton

HEATING DATA

Estimated maximum heating coil load	= 48.91 MBH
Capacity at 47.0 F outdoor air	= 53.0 MBH
Compressor, evaporator fan kW at 47.0 F outdoor air	= 6.2 kW
Outdoor air temperature for cutoff	= 0.0 F

AUXILIARY PLANT DATA

Plant type	= Electrical
Estimated maximum heating coil load	= 48.91 MBH
Type of heating	= Direct

****

4 PUMP SYSTEM DATA

(No inputs required)

****

AIR SYSTEM DESCRIPTION

Name : FIRST FLOOR 03-14-94
Carrier Hourly Analysis Program 6063092204
Prepared By : E.A.C., P.C. Burke, VA

****

1. SYSTEM NAME AND TYPE

System Name = FIRST FLOOR
System Class = Constant Volume
System Type = (SZCV) Single Zone Constant Volume
Operation Type = 3 Cooling & Heating
Type of Heating = 1 Central Heating

****

2. SPACE SELECTION (see separate printout)

****

3. THERMOSTAT & EQUIPMENT SCHEDULING DATA

Operation Period	Thermostat Setpoints Cooling	Thermostat Setpoints Heating	Ventilation Dampers
Occupied	78.0 F	70.0 F	OPEN
Unoccupied	78.0 F	70.0 F	OPEN

Weekday	: Occupied Period Begins at 9	; Duration	= 7 hrs
Saturday	: Occupied Period Begins at 15	; Duration	= 5 hrs
Sunday	: Occupied Period Begins at 10	; Duration	= 0 hrs
Design Day	: Occupied Period Begins at 9	; Duration	= 8 hrs

****

4. SUPPLY, VENTILATION, RETURN AIR DATA

SUPPLY AIR
Supply air flow rate = 2025.00 CFM
Heating supply temperature = 100.0 F
Fan operation for heating = 1 Continuous

VENTILATION AIR
Nominal ventilation flow rate = 380.00 CFM
Minimum ventilation flow rate = 0.00 CFM
Damper leak rate = 5 % of vent air

RETURN AIR
Zone exhaust air flow rate = 260.00 CFM
Zone exhaust fan power = 0.5 kW
Is a return plenum used ? N

****

****

5. FAN DATA

SUPPLY FAN

Type	=	2:Forward curved
Static	=	2.00 in wg
Efficiency	=	54 %
Configuration	=	1 Draw-thru

RETURN FAN

Type	=	1:(Fan does not exist)

****

6. ACCESSORY DEVICES AND SYSTEMS

PREHEAT COIL
(Not used)

OUTDOOR AIR ECONOMIZER CONTROL
(Not used)

VENTILATION AIR RECLAIM
(Not used)

HUMIDITY CONTROL
(Not used)

****

7. MISCELLANEOUS SYSTEM DATA

Cooling coil bypass factor	=	0.050
Type of supplemental heating	=	2 Skin Heating Units

SKIN HEATING UNITS

Heat source	=	1 Baseboard Heaters
Skin heating trip temperature	=	55.0 F

****

AIR SYSTEM SPACE LIST

Name : FIRST FLOOR | 03-14-94

Carrier Hourly Analysis Program | 6063092204

Prepared By : E.A.C., P.C. Burke, VA | Page 1

****

Space Name	Qty.	Space Name	Qty.
TABLE 1. SPACES IN ZONE 1			
2 CORRIDOR	x 1	5 MENS ROOM 1ST	x 2
3 STAIRWAY1ST	x 1	6 DINING ROOM - 1st	x 1

****

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1 PLANT NAME AND TYPES

Class	= Individual Plants
Name	= FOOD PREPARATION
Cooling Plant Type	= Air Cooled Reciprocating
Heating Plant Type	= User Defined

2 AIR SYSTEM SELECTION

Air System Name	Mult	Air System Name	Mult
FOOD PREPARATION AREA	1		

3a COOLING PLANT DATA (Air Cooled Reciprocating)

Estimated maximum cooling coil load	= 3.64 Ton
Is an electronic expansion valve used	? N
Capacity at 95.0 F outdoor air	= 3.75 Ton
Input power rate at 95.0 F outdoor air	= 2.000 kW/Ton
Type of cooling	= DX
Is hot gas bypass used	? N
One compressor per condenser circuit	? N

3b HEATING PLANT DATA (User Defined)

Estimated maximum heating coil load	= 0.00 MBH
Fuel or power source	= Natural Gas
Nominal plant capacity	= 0.0 MBH
Nominal plant efficiency	= 75 %
Type of heating	= Hydronic

PART LOAD PERFORMANCE

% Load	Eff. (%)	% Load	Eff. (%)	% Load	Eff. (%)
90 -----	75	60 -----	75	30 -----	75
80 -----	75	50 -----	75	20 -----	75
70 -----	75	40 -----	75	10 -----	75

4 PUMP SYSTEM DATA

Hot water pumping system head	= 0.00 ft wg
Hot water pumping system delta T	= 0.00 F

AIR SYSTEM DESCRIPTION

Name : FOOD PREPARATION AREA 03-14-94

Carrier Hourly Analysis Program 6063092204

Prepared By : E.A.C., P.C. Burke, VA

****

1. SYSTEM NAME AND TYPE

System Name = FOOD PREPARATION AREA
System Class = Constant Volume
System Type = (VENT) Ventilation
Operation Type = 1 Cooling Only

****

2. SPACE SELECTION (see separate printout)

****

3. THERMOSTAT & EQUIPMENT SCHEDULING DATA

Operation Period	Thermostat Setpoints Cooling	Thermostat Setpoints Heating	Ventilation Dampers
Occupied	80.0 F	50.0 F	OPEN
Unoccupied	N	50.0 F	CLOSED

Weekday	: Occupied Period Begins at	10	; Duration	= 6 hrs
Saturday	: Occupied Period Begins at	10	; Duration	= 10 hrs
Sunday	: Occupied Period Begins at	10	; Duration	= 10 hrs
Design Day	: Occupied Period Begins at	6	; Duration	= 16 hrs

****

4. SUPPLY, VENTILATION, RETURN AIR DATA

SUPPLY AIR
Supply air flow rate = 1380.00 CFM
Heating supply temperature = 52.0 F

VENTILATION AIR
Nominal ventilation flow rate = 100.00 % of supply air
Minimum ventilation flow rate = 0.00 % of supply air
Damper leak rate = 0 % of vent air

RETURN AIR
Zone exhaust air flow rate = 1535.00 CFM
Zone exhaust fan power = 0.8 kW
Is a return plenum used ? N

****

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AIR SYSTEM DESCRIPTION

****

5. FAN DATA

SUPPLY FAN

Type	=	2:Forward curved
Static	=	0.75 in wg
Efficiency	=	54 %
Configuration	=	1 Draw-thru

RETURN FAN

Type	=	1:(Fan does not exist)

****

6. ACCESSORY DEVICES AND SYSTEMS

PREHEAT COIL
(Not available)

OUTDOOR AIR ECONOMIZER CONTROL
(Not available)

VENTILATION AIR RECLAIM
(Not available)

HUMIDITY CONTROL
(Not available)

****

7. MISCELLANEOUS SYSTEM DATA

Cooling coil bypass factor = 0.050

****

AIR SYSTEM SPACE LIST

Name : FOOD PREPARATION AREA 03-14-94
Carrier Hourly Analysis Program 6063092204
Prepared By : E.A.C., P.C. Burke, VA

Space Name	Qty.	Space Name	Qty.
TABLE 1. SPACES IN ZONE 1			
4 FOOD PREP 1ST	x 1		

PLANT DESCRIPTIONS

****

1 PLANT NAME AND TYPES

Class	= Heat Pumps
Name	= BALCONY
Heat Pump Type	= Air Source Heat Pump
Auxiliary Plant Type	= Electrical Resistance

****

2 AIR SYSTEM SELECTION

Air System Name	Mult	Air System Name	Mult
BALCONY	1		

****

3 PLANT CHARACTERISTICS (Air Source Heat Pump)

COOLING DATA

Estimated maximum cooling coil load	= 1.81 Ton
Capacity at 95.0 F outdoor air	= 3.46 Ton
Input power rate at 95.0 F outdoor air	= 1.600 kW/Ton

HEATING DATA

Estimated maximum heating coil load	= 19.82 MBH
Capacity at 47.0 F outdoor air	= 44.8 MBH
Compressor, evaporator fan kW at 47.0 F outdoor air	= 4.2 kW
Outdoor air temperature for cutoff	= 0.0 F

AUXILIARY PLANT DATA

Plant type	= Electrical
Estimated maximum heating coil load	= 19.82 MBH
Type of heating	= Direct

****

4 PUMP SYSTEM DATA

(No inputs required)

****

AIR SYSTEM DESCRIPTION

Name : BALCONY 03-14-94
Carrier Hourly Analysis Program 6063092204
Prepared By : E.A.C., P.C. Burke, VA

****

1. SYSTEM NAME AND TYPE

System Name = BALCONY
System Class = Constant Volume
System Type = (SZCV) Single Zone Constant Volume
Operation Type = 3 Cooling & Heating
Type of Heating = 1 Central Heating

****

2. SPACE SELECTION (see separate printout)

****

3. THERMOSTAT & EQUIPMENT SCHEDULING DATA

Operation Period	Thermostat Setpoints Cooling	Thermostat Setpoints Heating	Ventilation Dampers
Occupied	78.0 F	70.0 F	OPEN
Unoccupied	78.0 F	70.0 F	OPEN

Weekday	: Occupied Period Begins at	9 ; Duration	= 7 hrs
Saturday	: Occupied Period Begins at	15 ; Duration	= 5 hrs
Sunday	: Occupied Period Begins at	9 ; Duration	= 0 hrs
Design Day	: Occupied Period Begins at	9 ; Duration	= 8 hrs

****

4. SUPPLY, VENTILATION, RETURN AIR DATA

SUPPLY AIR
Supply air temperature = 59.0 F
Heating supply temperature = 100.0 F
Fan operation for heating = 1 Continuous

VENTILATION AIR
Nominal ventilation flow rate = 170.00 CFM
Minimum ventilation flow rate = 0.00 CFM
Damper leak rate = 5 % of vent air

RETURN AIR
Zone exhaust air flow rate = 0.00 CFM
Zone exhaust fan power = 0.0 kW
Is a return plenum used ? N

****

****
5. FAN DATA
SUPPLY FAN
Type = 2:Forward curved
Static = 2.00 in wg
Efficiency = 54 %
Configuration = 1 Draw-thru
RETURN FAN
Type = 1:(Fan does not exist)
****
6. ACCESSORY DEVICES AND SYSTEMS
PREHEAT COIL
(Not used)
OUTDOOR AIR ECONOMIZER CONTROL
(Not used)
VENTILATION AIR RECLAIM
(Not used)
HUMIDITY CONTROL
(Not used)
****
7. MISCELLANEOUS SYSTEM DATA
Cooling coil bypass factor = 0.050
Type of supplemental heating = 1 Not Used
****

712

AIR SYSTEM SPACE LIST

Name : BALCONY | 03-14-94
Carrier Hourly Analysis Program | 6063092204
Prepared By : E.A.C., P.C. Burke, VA | Page 1

Space Name	Qty.	Space Name	Qty.
TABLE 1. SPACES IN ZONE 1			
1 BALCONY	x 1		

7.15

COMPLEX SPACE DESCRIPTION

Space Name : BALCONY
Prepared By : E.A.C., P.C. Burke, VA
Carrier Hourly Analysis Program

1. SPACE NAME = BALCONY

2. WALL INFORMATION (Number of Wall Types = 1)

	Weight (lb/sqft)	Ext Color (D,M,L)	U-Value (BTU/hr/sqft/F)
Wall Type 1	M	D	0.069

	<-------- Net Wall Areas (sqft) -------->		
Exposure	Wall Type 1	Wall Type 2	Wall Type 3
NE	0.0	NA	NA
E	0.0	NA	NA
SE	0.0	NA	NA
S	0.0	NA	NA
SW	0.0	NA	NA
W	0.0	NA	NA
NW	0.0	NA	NA
N	0.0	NA	NA

3. ROOF INFORMATION (Number of Roof Types = 1)

	Weight (lb/sqft)	Ext Color (D,M,L)	U-Value (BTU/hr/sqft/F)	Area (sqft)
Roof 1	M	D	0.093	520.0

4. GLASS INFORMATION (Number of Glass Types = 1)

	U-Value (BTU/hr/sqft/F)	Glass Factor	Internal Shades
Glass Type 1	0.590	0.65	Y

	<---------------- External Shading Information					---------------->
	Window Height (ft)	Window Width (ft)	Reveal Depth (in)	Overhang Height (in)	Overhang Extension (in)	Fin Separation (in)	Fin Exten. (in)
Shade 1	8.0	4.0	0.0	0.0	0.0	0.0	0.0
Shade 2	8.0	4.0	0.0	0.0	0.0	0.0	0.0
Shade 3	8.0	4.0	0.0	0.0	0.0	0.0	0.0

4. GLASS INFORMATION (continued)

Exposure	Glass Areas (sqft) Type 1 Area	Type 1 Shade	Type 2 Area	Type 2 Shade	Type 3 Area	Type 3 Shade
NE	0.0	0	NA	NA	NA	NA
E	0.0	0	NA	NA	NA	NA
SE	0.0	0	NA	NA	NA	NA
S	0.0	0	NA	NA	NA	NA
SW	0.0	0	NA	NA	NA	NA
W	0.0	0	NA	NA	NA	NA
NW	0.0	0	NA	NA	NA	NA
N	0.0	0	NA	NA	NA	NA
H	0.0	0	NA	NA	NA	NA

5. INTERNAL LOADS

SPACE DATA	: Floor Area	=	464 sqft	Building Wt.	=	M lb/sqft
PEOPLE	: sqft/person	=	19.3	Total People	=	24
	Schedule No.	=	1	Activity Level	=	1
LIGHTING	: W/sqft	=	1.51	Total Watts	=	700
	Schedule No.	=	2	Wattage Mult.	=	1.00
	Fixture Type	=	1 Recessed, not vented			
OTHER ELECTRIC:	W/sqft	=	0.00	Total Watts	=	0
	Schedule No.	=	1			
MISC. SENSIBLE:	Load	=	0 BTU/hr	Schedule No.	=	1
MISC. LATENT	: Load	=	0 BTU/hr	Schedule No.	=	1

6. PARTITIONS, INFILTRATION, GROUND

PARTITIONS (Next to Unconditioned Spaces)	Area (sqft)	U-Value (BTU/hr/sqft/F)	Unconditioned Space Temp. Cooling (deg F or %)	Heating (deg F or %)
Walls	416.0	0.725	90.0 F	55.0 F
Ceilings	0.0	0.100	90.0 F	50.0 F
Floors	0.0	0.100	90.0 F	50.0 F

INFILTRATION			GROUND ELEMENT	
Cooling	: 0.10 CFM/sqft =	46 CFM	Area :	0.0 sqft
Heating	: 0.15 CFM/sqft =	70 CFM	Perimeter :	0.0 ft
Typical	: 0.15 CFM/sqft =	70 CFM	Depth :	0.0 ft

COMPLEX SPACE DESCRIPTION

Space Name : CORRIDOR
Prepared By : E.A.C., P.C.   Burke, VA
Carrier Hourly Analysis Program

****

1. SPACE NAME = CORRIDOR

****

2. WALL INFORMATION (Number of Wall Types = 1)

	Weight (lb/sqft)	Ext Color (D,M,L)	U-Value (BTU/hr/sqft/F)
Wall Type 1	M	D	0.069

	<-------- Net Wall Areas (sqft) -------->		
Exposure	Wall Type 1	Wall Type 2	Wall Type 3
NE	0.0	NA	NA
E	0.0	NA	NA
SE	0.0	NA	NA
S	0.0	NA	NA
SW	0.0	NA	NA
W	0.0	NA	NA
NW	0.0	NA	NA
N	0.0	NA	NA

****

3. ROOF INFORMATION (Number of Roof Types = 1)

	Weight (lb/sqft)	Ext Color (D,M,L)	U-Value (BTU/hr/sqft/F)	Area (sqft)
Roof 1	M	D	0.093	0.0

****

4. GLASS INFORMATION (Number of Glass Types = 1)

	U-Value (BTU/hr/sqft/F)	Glass Factor	Internal Shades
Glass Type 1	0.590	0.65	Y

	<--------------- External Shading Information -------------->						
	Window Height (ft)	Window Width (ft)	Reveal Depth (in)	Overhang Height (in)	Overhang Extension (in)	Fin Separation (in)	Fin Exten. (in)
Shade 1	8.0	4.0	0.0	0.0	0.0	0.0	0.0
Shade 2	8.0	4.0	0.0	0.0	0.0	0.0	0.0
Shade 3	8.0	4.0	0.0	0.0	0.0	0.0	0.0

****

COMPLEX SPACE DESCRIPTION

Space Name : CORRIDOR — 03-14-94
Prepared By : E.A.C., P.C. Burke, VA — 6063092204
Carrier Hourly Analysis Program —

****

4. GLASS INFORMATION (continued)

	<------ Glass Areas (sqft) ------>					
	Type 1		Type 2		Type 3	
Exposure	Area	Shade	Area	Shade	Area	Shade
NE	0.0	0	NA	NA	NA	NA
E	0.0	0	NA	NA	NA	NA
SE	0.0	0	NA	NA	NA	NA
S	0.0	0	NA	NA	NA	NA
SW	0.0	0	NA	NA	NA	NA
W	0.0	0	NA	NA	NA	NA
NW	0.0	0	NA	NA	NA	NA
N	0.0	0	NA	NA	NA	NA
H	0.0	0	NA	NA	NA	NA

****

5. INTERNAL LOADS

SPACE DATA : Floor Area = 115 sqft Building Wt. = M lb/sqft

PEOPLE : sqft/person = 28.8 Total People = 4
Schedule No. = 1 Activity Level = 1

LIGHTING : W/sqft = 1.51 Total Watts = 173
Schedule No. = 2 Wattage Mult. = 1.00
Fixture Type = 1 Recessed, not vented

OTHER ELECTRIC: W/sqft = 0.00 Total Watts = 0
Schedule No. = 1

MISC. SENSIBLE: Load = 0 BTU/hr Schedule No. = 1
MISC. LATENT : Load = 0 BTU/hr Schedule No. = 1

****

6. PARTITIONS, INFILTRATION, GROUND

PARTITIONS (Next to Unconditioned Spaces)	Area (sqft)	U-Value (BTU/hr/sqft/F)	Unconditioned Space Temp. Cooling (deg F or %)	Heating (deg F or %)
Walls	0.0	0.725	90.0 F	55.0 F
Ceilings	0.0	0.100	90.0 F	50.0 F
Floors	0.0	0.100	90.0 F	50.0 F

INFILTRATION			GROUND ELEMENT	
Cooling	: 0.10 CFM/sqft =	12 CFM	Area :	0.0 sqft
Heating	: 0.15 CFM/sqft =	17 CFM	Perimeter :	0.0 ft
Typical	: 0.15 CFM/sqft =	17 CFM	Depth :	0.0 ft

****

1. SPACE NAME = STAIRWAY1ST

2. WALL INFORMATION (Number of Wall Types = 1)

	Weight (lb/sqft)	Ext Color (D,M,L)	U-Value (BTU/hr/sqft/F)
Wall Type 1	M	D	0.069

Exposure	<-------- Net Wall Areas (sqft) --------> Wall Type 1	Wall Type 2	Wall Type 3
NE	0.0	NA	NA
E	0.0	NA	NA
SE	89.3	NA	NA
S	0.0	NA	NA
SW	238.0	NA	NA
W	0.0	NA	NA
NW	89.3	NA	NA
N	0.0	NA	NA

3. ROOF INFORMATION (Number of Roof Types = 1)

	Weight (lb/sqft)	Ext Color (D,M,L)	U-Value (BTU/hr/sqft/F)	Area (sqft)
Roof 1	M	D	0.093	212.5

4. GLASS INFORMATION (Number of Glass Types = 1)

	U-Value (BTU/hr/sqft/F)	Glass Factor	Internal Shades
Glass Type 1	0.590	0.65	N

<---------------- External Shading Information ---------------->

	Window Height (ft)	Window Width (ft)	Reveal Depth (in)	Overhang Height (in)	Overhang Extension (in)	Fin Separation (in)	Fin Exten. (in)
Shade 1	7.0	6.0	3.0	84.0	48.0	60.0	48.0
Shade 2	3.0	6.0	3.0	12.0	48.0	12.0	48.0
Shade 3	3.0	6.0	3.0	12.0	48.0	12.0	48.0

COMPLEX SPACE DESCRIPTION

Space Name : STAIRWAY1ST
Prepared By : E.A.C., P.C.   Burke, VA
Carrier Hourly Analysis Program

****

4. GLASS INFORMATION (continued)

	Glass Areas (sqft)					
	Type 1		Type 2		Type 3	
Exposure	Area	Shade	Area	Shade	Area	Shade
NE	0.0	0	NA	NA	NA	NA
E	0.0	0	NA	NA	NA	NA
SE	0.0	0	NA	NA	NA	NA
S	0.0	0	NA	NA	NA	NA
SW	139.0	0	NA	NA	NA	NA
W	0.0	0	NA	NA	NA	NA
NW	0.0	0	NA	NA	NA	NA
N	0.0	0	NA	NA	NA	NA
H	0.0	0	NA	NA	NA	NA

****

5. INTERNAL LOADS

SPACE DATA	: Floor Area	=	357 sqft	Building Wt.	=	M lb/sqft
PEOPLE	: sqft/person	=	71.4	Total People	=	5
	Schedule No.	=	1	Activity Level	=	3
LIGHTING	: W/sqft	=	1.51	Total Watts	=	539
	Schedule No.	=	2	Wattage Mult.	=	1.00
	Fixture Type	=	1 Recessed, not vented			
OTHER ELECTRIC:	W/sqft	=	0.84	Total Watts	=	300
	Schedule No.	=	1			
MISC. SENSIBLE:	Load	=	0 BTU/hr	Schedule No.	=	1
MISC. LATENT	: Load	=	0 BTU/hr	Schedule No.	=	1

****

6. PARTITIONS, INFILTRATION, GROUND

PARTITIONS (Next to Unconditioned Spaces)	Area (sqft)	U-Value (BTU/hr/sqft/F)	Unconditioned Space Temp. Cooling (deg F or %)	Heating (deg F or %)
Walls	0.0	0.725	90.0 F	55.0 F
Ceilings	0.0	0.100	90.0 F	50.0 F
Floors	0.0	0.100	90.0 F	50.0 F

INFILTRATION			GROUND ELEMENT	
Cooling	: 0.10 CFM/sqft =	36 CFM	Area :	0.0 sqft
Heating	: 0.15 CFM/sqft =	54 CFM	Perimeter :	0.0 ft
Typical	: 0.15 CFM/sqft =	54 CFM	Depth :	0.0 ft

****

1. SPACE NAME = FOOD PREP 1ST

2. WALL INFORMATION (Number of Wall Types = 2)

	Weight (lb/sqft)	Ext Color (D,M,L)	U-Value (BTU/hr/sqft/F)
Wall Type 1	M	D	0.069
Wall Type 2	M	M	0.330

Exposure	<-------- Net Wall Areas (sqft) --------> Wall Type 1	Wall Type 2	Wall Type 3
NE	0.0	0.0	NA
E	0.0	0.0	NA
SE	246.8	21.0	NA
S	0.0	0.0	NA
SW	0.0	0.0	NA
W	0.0	0.0	NA
NW	0.0	0.0	NA
N	0.0	0.0	NA

3. ROOF INFORMATION (Number of Roof Types = 1)

	Weight (lb/sqft)	Ext Color (D,M,L)	U-Value (BTU/hr/sqft/F)	Area (sqft)
Roof 1	M	D	0.093	0.0

4. GLASS INFORMATION (Number of Glass Types = 1)

	U-Value (BTU/hr/sqft/F)	Glass Factor	Internal Shades
Glass Type 1	0.590	0.65	N

<---------------- External Shading Information ---------------->

	Window Height (ft)	Window Width (ft)	Reveal Depth (in)	Overhang Height (in)	Overhang Extension (in)	Fin Separation (in)	Fin Exten. (in)
Shade 1	7.0	6.0	3.0	84.0	48.0	60.0	48.0
Shade 2	3.0	6.0	3.0	12.0	48.0	12.0	48.0
Shade 3	3.0	6.0	3.0	12.0	48.0	12.0	48.0

4. GLASS INFORMATION (continued)

	Glass Areas (sqft)					
	Type 1		Type 2		Type 3	
Exposure	Area	Shade	Area	Shade	Area	Shade
NE	0.0	0	NA	NA	NA	NA
E	0.0	0	NA	NA	NA	NA
SE	0.0	0	NA	NA	NA	NA
S	0.0	0	NA	NA	NA	NA
SW	0.0	0	NA	NA	NA	NA
W	0.0	0	NA	NA	NA	NA
NW	0.0	0	NA	NA	NA	NA
N	0.0	0	NA	NA	NA	NA
H	0.0	0	NA	NA	NA	NA

5. INTERNAL LOADS

SPACE DATA	: Floor Area	=	487 sqft	Building Wt. =	M lb/sqft
PEOPLE	: sqft/person	=	97.4	Total People =	5
	Schedule No.	=	1	Activity Level =	5
LIGHTING	: W/sqft	=	2.50	Total Watts =	1,218
	Schedule No.	=	2	Wattage Mult. =	1.50
	Fixture Type	=	1 Recessed, not vented		
OTHER ELECTRIC:	W/sqft	=	6.43	Total Watts =	3,132
	Schedule No.	=	1		
MISC. SENSIBLE:	Load	=	0 BTU/hr	Schedule No. =	1
MISC. LATENT	: Load	=	0 BTU/hr	Schedule No. =	1

6. PARTITIONS, INFILTRATION, GROUND

PARTITIONS (Next to Unconditioned Spaces)	Area (sqft)	U-Value (BTU/hr/sqft/F)	Unconditioned Space Temp. Cooling (deg F or %)	Heating (deg F or %)
Walls	0.0	0.725	90.0 F	55.0 F
Ceilings	0.0	0.100	90.0 F	50.0 F
Floors	0.0	0.100	90.0 F	50.0 F

INFILTRATION			GROUND ELEMENT	
Cooling	: 0.10 CFM/sqft =	49 CFM	Area :	0.0 sqft
Heating	: 0.15 CFM/sqft =	73 CFM	Perimeter :	0.0 ft
Typical	: 0.15 CFM/sqft =	73 CFM	Depth :	0.0 ft

COMPLEX SPACE DESCRIPTION

Space Name : MENS ROOM 1ST — 03-14-94
Prepared By : E.A.C., P.C. Burke, VA — 6063092204
Carrier Hourly Analysis Program —

****

1. SPACE NAME = MENS ROOM 1ST

****

2. WALL INFORMATION (Number of Wall Types = 1)

	Weight (lb/sqft)	Ext Color (D,M,L)	U-Value (BTU/hr/sqft/F)
Wall Type 1	M	D	0.069

	<-------- Net Wall Areas (sqft) -------->		
Exposure	Wall Type 1	Wall Type 2	Wall Type 3
NE	0.0	NA	NA
E	0.0	NA	NA
SE	0.0	NA	NA
S	0.0	NA	NA
SW	0.0	NA	NA
W	0.0	NA	NA
NW	0.0	NA	NA
N	0.0	NA	NA

****

3. ROOF INFORMATION (Number of Roof Types = 1)

	Weight (lb/sqft)	Ext Color (D,M,L)	U-Value (BTU/hr/sqft/F)	Area (sqft)
Roof 1	M	D	0.093	0.0

****

4. GLASS INFORMATION (Number of Glass Types = 1)

	U-Value (BTU/hr/sqft/F)	Glass Factor	Internal Shades
Glass Type 1	0.590	0.65	N

	<---------------- External Shading Information ---------------- >						
	Window Height (ft)	Window Width (ft)	Reveal Depth (in)	Overhang Height (in)	Overhang Extension (in)	Fin Separation (in)	Fin Exten. (in)
Shade 1	7.0	6.0	3.0	84.0	48.0	60.0	48.0
Shade 2	3.0	6.0	3.0	12.0	48.0	12.0	48.0
Shade 3	3.0	6.0	3.0	12.0	48.0	12.0	48.0

****

COMPLEX SPACE DESCRIPTION

Space Name : MENS ROOM 1ST
Prepared By : E.A.C., P.C. Burke, VA
Carrier Hourly Analysis Program

4. GLASS INFORMATION (continued)

	Glass Areas (sqft)					
	Type 1		Type 2		Type 3	
Exposure	Area	Shade	Area	Shade	Area	Shade
NE	0.0	0	NA	NA	NA	NA
E	0.0	0	NA	NA	NA	NA
SE	0.0	0	NA	NA	NA	NA
S	0.0	0	NA	NA	NA	NA
SW	0.0	0	NA	NA	NA	NA
W	0.0	0	NA	NA	NA	NA
NW	0.0	0	NA	NA	NA	NA
N	0.0	0	NA	NA	NA	NA
H	0.0	0	NA	NA	NA	NA

5. INTERNAL LOADS

SPACE DATA	: Floor Area =	59 sqft	Building Wt. =	M lb/sqft
PEOPLE	: sqft/person =	0.0	Total People =	0
	Schedule No. =	1	Activity Level =	1
LIGHTING	: W/sqft =	1.71	Total Watts =	100
	Schedule No. =	2	Wattage Mult. =	1.00
	Fixture Type =	1 Recessed, not vented		
OTHER ELECTRIC:	W/sqft =	5.64	Total Watts =	330
	Schedule No. =	1		
MISC. SENSIBLE:	Load =	0 BTU/hr	Schedule No. =	1
MISC. LATENT :	Load =	0 BTU/hr	Schedule No. =	1

6. PARTITIONS, INFILTRATION, GROUND

PARTITIONS (Next to Unconditioned Spaces)	Area (sqft)	U-Value (BTU/hr/sqft/F)	Unconditioned Space Temp. Cooling (deg F or %)	Heating (deg F or %)
Walls	0.0	0.725	90.0 F	55.0 F
Ceilings	0.0	0.100	90.0 F	50.0 F
Floors	0.0	0.100	90.0 F	50.0 F

INFILTRATION			GROUND ELEMENT	
Cooling	: 0.10 CFM/sqft =	6 CFM	Area :	0.0 sqft
Heating	: 0.15 CFM/sqft =	9 CFM	Perimeter :	0.0 ft
Typical	: 0.15 CFM/sqft =	9 CFM	Depth :	0.0 ft

COMPLEX SPACE DESCRIPTION

1. SPACE NAME = DINING ROOM - 1st

2. WALL INFORMATION (Number of Wall Types = 2)

	Weight (lb/sqft)	Ext Color (D,M,L)	U-Value (BTU/hr/sqft/F)
Wall Type 1	M	D	0.069
Wall Type 2	M	M	0.330

	<-------- Net Wall Areas (sqft) -------->		
Exposure	Wall Type 1	Wall Type 2	Wall Type 3
NE	321.0	0.0	NA
E	0.0	0.0	NA
SE	257.0	0.0	NA
S	0.0	0.0	NA
SW	0.0	0.0	NA
W	0.0	0.0	NA
NW	218.0	25.0	NA
N	0.0	0.0	NA

3. ROOF INFORMATION (Number of Roof Types = 1)

	Weight (lb/sqft)	Ext Color (D,M,L)	U-Value (BTU/hr/sqft/F)	Area (sqft)
Roof 1	M	D	0.093	515.0

4. GLASS INFORMATION (Number of Glass Types = 1)

	U-Value (BTU/hr/sqft/F)	Glass Factor	Internal Shades
Glass Type 1	0.590	0.65	N

	<---------------- External Shading Information ---------------->						
	Window Height (ft)	Window Width (ft)	Reveal Depth (in)	Overhang Height (in)	Overhang Extension (in)	Fin Separation (in)	Fin Exten. (in)
Shade 1	7.0	6.0	3.0	84.0	48.0	60.0	48.0
Shade 2	3.0	6.0	3.0	12.0	48.0	12.0	48.0
Shade 3	3.0	6.0	3.0	12.0	48.0	12.0	48.0

COMPLEX SPACE DESCRIPTION

Space Name : DINING ROOM - 1st
Prepared By : E.A.C., P.C. Burke, VA
Carrier Hourly Analysis Program

4. GLASS INFORMATION (continued)

	Glass Areas (sqft)					
	Type 1		Type 2		Type 3	
Exposure	Area	Shade	Area	Shade	Area	Shade
NE	237.0	1	NA	NA	NA	NA
E	0.0	0	NA	NA	NA	NA
SE	14.0	2	NA	NA	NA	NA
S	0.0	0	NA	NA	NA	NA
SW	0.0	0	NA	NA	NA	NA
W	0.0	0	NA	NA	NA	NA
NW	14.0	2	NA	NA	NA	NA
N	0.0	0	NA	NA	NA	NA
H	0.0	0	NA	NA	NA	NA

5. INTERNAL LOADS

SPACE DATA : Floor Area = 1,904 sqft Building Wt. = M lb/sqft

PEOPLE : sqft/person = 52.9 Total People = 36
Schedule No. = 1 Activity Level = 1

LIGHTING : W/sqft = 0.68 Total Watts = 1,300
Schedule No. = 2 Wattage Mult. = 1.00
Fixture Type = 1 Recessed, not vented

OTHER ELECTRIC: W/sqft = 0.70 Total Watts = 1,330
Schedule No. = 1

MISC. SENSIBLE: Load = 0 BTU/hr Schedule No. = 1
MISC. LATENT : Load = 0 BTU/hr Schedule No. = 1

6. PARTITIONS, INFILTRATION, GROUND

PARTITIONS (Next to Unconditioned Spaces)	Area (sqft)	U-Value (BTU/hr/sqft/F)	Unconditioned Space Temp. Cooling (deg F or %)	Heating (deg F or %)
Walls	0.0	0.725	90.0 F	55.0 F
Ceilings	0.0	0.100	90.0 F	50.0 F
Floors	0.0	0.100	90.0 F	50.0 F

INFILTRATION			GROUND ELEMENT	
Cooling	: 0.10 CFM/sqft =	190 CFM	Area :	0.0 sqft
Heating	: 0.15 CFM/sqft =	286 CFM	Perimeter :	0.0 ft
Typical	: 0.15 CFM/sqft =	286 CFM	Depth :	0.0 ft

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COMPLEX SPACE DESCRIPTION

Space Name : CASUAL/BAR AREA BSMT 03-14-94
Prepared By : E.A.C., P.C. Burke, VA 6063092204
Carrier Hourly Analysis Program

****

1. SPACE NAME = CASUAL/BAR AREA BSMT

****

2. WALL INFORMATION (Number of Wall Types = 1)

	Weight (lb/sqft)	Ext Color (D,M,L)	U-Value (BTU/hr/sqft/F)
Wall Type 1	M	D	0.148

Exposure	<-------- Net Wall Areas (sqft) --------> Wall Type 1	Wall Type 2	Wall Type 3
NE	0.0	NA	NA
E	0.0	NA	NA
SE	530.0	NA	NA
S	0.0	NA	NA
SW	0.0	NA	NA
W	362.0	NA	NA
NW	0.0	NA	NA
N	0.0	NA	NA

****

3. ROOF INFORMATION (Number of Roof Types = 1)

	Weight (lb/sqft)	Ext Color (D,M,L)	U-Value (BTU/hr/sqft/F)	Area (sqft)
Roof 1	M	D	0.093	0.0

****

4. GLASS INFORMATION (Number of Glass Types = 1)

	U-Value (BTU/hr/sqft/F)	Glass Factor	Internal Shades
Glass Type 1	0.590	0.65	N

<---------------- External Shading Information ---------------->

	Window Height (ft)	Window Width (ft)	Reveal Depth (in)	Overhang Height (in)	Overhang Extension (in)	Fin Separation (in)	Fin Exten. (in)
Shade 1	7.0	6.0	3.0	84.0	48.0	60.0	48.0
Shade 2	3.0	6.0	3.0	12.0	48.0	12.0	48.0
Shade 3	3.0	6.0	3.0	12.0	48.0	12.0	48.0

****

4. GLASS INFORMATION (continued)

	Glass Areas (sqft)					
	Type 1		Type 2		Type 3	
Exposure	Area	Shade	Area	Shade	Area	Shade
NE	0.0	0	NA	NA	NA	NA
E	0.0	0	NA	NA	NA	NA
SE	0.0	0	NA	NA	NA	NA
S	0.0	0	NA	NA	NA	NA
SW	0.0	0	NA	NA	NA	NA
W	0.0	0	NA	NA	NA	NA
NW	0.0	0	NA	NA	NA	NA
N	0.0	0	NA	NA	NA	NA
H	0.0	0	NA	NA	NA	NA

5. INTERNAL LOADS

SPACE DATA	: Floor Area	=	1,303 sqft	Building Wt.	=	M lb/sqft
PEOPLE	: sqft/person	=	40.7	Total People	=	32
	Schedule No.	=	1	Activity Level	=	1
LIGHTING	: W/sqft	=	1.84	Total Watts	=	2,400
	Schedule No.	=	2	Wattage Mult.	=	1.00
	Fixture Type	=	1 Recessed, not vented			
OTHER ELECTRIC:	W/sqft	=	1.24	Total Watts	=	1,620
	Schedule No.	=	1			
MISC. SENSIBLE:	Load	=	0 BTU/hr	Schedule No.	=	1
MISC. LATENT	: Load	=	0 BTU/hr	Schedule No.	=	1

6. PARTITIONS, INFILTRATION, GROUND

PARTITIONS (Next to Unconditioned Spaces)	Area (sqft)	U-Value (BTU/hr/sqft/F)	Unconditioned Space Temp. Cooling (deg F or %)	Heating (deg F or %)
Walls	0.0	0.725	90.0 F	55.0 F
Ceilings	0.0	0.100	90.0 F	50.0 F
Floors	0.0	0.082	70.0 F	55.0 F

INFILTRATION			GROUND ELEMENT		
Cooling	: 0.10 CFM/sqft =	130 CFM	Area	:	1,303.0 sqft
Heating	: 0.15 CFM/sqft =	195 CFM	Perimeter	:	65.0 ft
Typical	: 0.10 CFM/sqft =	130 CFM	Depth	:	0.0 ft

COMPLEX SPACE DESCRIPTION

****

1. SPACE NAME = MENS BSMT

****

2. WALL INFORMATION (Number of Wall Types = 1)

	Weight (lb/sqft)	Ext Color (D,M,L)	U-Value (BTU/hr/sqft/F)
Wall Type 1	M	D	0.148

Exposure	<-------- Net Wall Areas (sqft) --------> Wall Type 1	Wall Type 2	Wall Type 3
NE	0.0	NA	NA
E	0.0	NA	NA
SE	0.0	NA	NA
S	0.0	NA	NA
SW	0.0	NA	NA
W	0.0	NA	NA
NW	0.0	NA	NA
N	0.0	NA	NA

****

3. ROOF INFORMATION (Number of Roof Types = 1)

	Weight (lb/sqft)	Ext Color (D,M,L)	U-Value (BTU/hr/sqft/F)	Area (sqft)
Roof 1	M	D	0.093	0.0

****

4. GLASS INFORMATION (Number of Glass Types = 1)

	U-Value (BTU/hr/sqft/F)	Glass Factor	Internal Shades
Glass Type 1	0.590	0.65	N

	<---------------- External Shading Information ---------------->						
	Window Height (ft)	Window Width (ft)	Reveal Depth (in)	Overhang Height (in)	Overhang Extension (in)	Fin Separation (in)	Fin Exten. (in)
Shade 1	7.0	6.0	3.0	84.0	48.0	60.0	48.0
Shade 2	3.0	6.0	3.0	12.0	48.0	12.0	48.0
Shade 3	3.0	6.0	3.0	12.0	48.0	12.0	48.0

****

COMPLEX SPACE DESCRIPTION

Space Name : MENS BSMT
Prepared By : E.A.C., P.C. Burke, VA
Carrier Hourly Analysis Program

4. GLASS INFORMATION (continued)

	Glass Areas (sqft)					
	Type 1		Type 2		Type 3	
Exposure	Area	Shade	Area	Shade	Area	Shade
NE	0.0	0	NA	NA	NA	NA
E	0.0	0	NA	NA	NA	NA
SE	0.0	0	NA	NA	NA	NA
S	0.0	0	NA	NA	NA	NA
SW	0.0	0	NA	NA	NA	NA
W	0.0	0	NA	NA	NA	NA
NW	0.0	0	NA	NA	NA	NA
N	0.0	0	NA	NA	NA	NA
H	0.0	0	NA	NA	NA	NA

5. INTERNAL LOADS

SPACE DATA : Floor Area = 74 sqft Building Wt. = M lb/sqft

PEOPLE : sqft/person = 0.0 Total People = 0
Schedule No. = 1 Activity Level = 1

LIGHTING : W/sqft = 1.08 Total Watts = 80
Schedule No. = 2 Wattage Mult. = 1.25
Fixture Type = 1 Recessed, not vented

OTHER ELECTRIC: W/sqft = 4.46 Total Watts = 330
Schedule No. = 1

MISC. SENSIBLE: Load = 0 BTU/hr Schedule No. = 1
MISC. LATENT : Load = 0 BTU/hr Schedule No. = 1

6. PARTITIONS, INFILTRATION, GROUND

PARTITIONS (Next to Unconditioned Spaces)	Area (sqft)	U-Value (BTU/hr/sqft/F)	Unconditioned Space Temp. Cooling (deg F or %)	Heating (deg F or %)
Walls	0.0	0.725	90.0 F	55.0 F
Ceilings	0.0	0.100	90.0 F	50.0 F
Floors	0.0	0.082	90.0 F	55.0 F

INFILTRATION			GROUND ELEMENT	
Cooling	: 0.10 CFM/sqft =	7 CFM	Area :	74.0 sqft
Heating	: 0.15 CFM/sqft =	11 CFM	Perimeter :	21.0 ft
Typical	: 0.15 CFM/sqft =	11 CFM	Depth :	10.0 ft

COMPLEX SPACE DESCRIPTION

Space Name : LADIES BSMT 03-14-94
Prepared By : E.A.C., P.C. Burke, VA 6063092204
Carrier Hourly Analysis Program

****

1. SPACE NAME = LADIES BSMT

****

2. WALL INFORMATION (Number of Wall Types = 1)

	Weight (lb/sqft)	Ext Color (D,M,L)	U-Value (BTU/hr/sqft/F)
Wall Type 1	M	D	0.148

Exposure	<-------- Net Wall Areas (sqft) --------> Wall Type 1	Wall Type 2	Wall Type 3
NE	0.0	NA	NA
E	0.0	NA	NA
SE	0.0	NA	NA
S	0.0	NA	NA
SW	0.0	NA	NA
W	0.0	NA	NA
NW	0.0	NA	NA
N	0.0	NA	NA

****

3. ROOF INFORMATION (Number of Roof Types = 1)

	Weight (lb/sqft)	Ext Color (D,M,L)	U-Value (BTU/hr/sqft/F)	Area (sqft)
Roof 1	M	D	0.093	0.0

****

4. GLASS INFORMATION (Number of Glass Types = 1)

	U-Value (BTU/hr/sqft/F)	Glass Factor	Internal Shades
Glass Type 1	0.590	0.65	N

<--------------- External Shading Information --------------->

	Window Height (ft)	Window Width (ft)	Reveal Depth (in)	Overhang Height (in)	Overhang Extension (in)	Fin Separation (in)	Fin Exten. (in)
Shade 1	7.0	6.0	3.0	84.0	48.0	60.0	48.0
Shade 2	3.0	6.0	3.0	12.0	48.0	12.0	48.0
Shade 3	3.0	6.0	3.0	12.0	48.0	12.0	48.0

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COMPLEX SPACE DESCRIPTION

Space Name : LADIES BSMT 03-14-94
Prepared By : E.A.C., P.C. Burke, VA 6063092204
Carrier Hourly Analysis Program

4. GLASS INFORMATION (continued)

	Glass Areas (sqft)					
	Type 1		Type 2		Type 3	
Exposure	Area	Shade	Area	Shade	Area	Shade
NE	0.0	0	NA	NA	NA	NA
E	0.0	0	NA	NA	NA	NA
SE	0.0	0	NA	NA	NA	NA
S	0.0	0	NA	NA	NA	NA
SW	0.0	0	NA	NA	NA	NA
W	0.0	0	NA	NA	NA	NA
NW	0.0	0	NA	NA	NA	NA
N	0.0	0	NA	NA	NA	NA
H	0.0	0	NA	NA	NA	NA

5. INTERNAL LOADS

SPACE DATA : Floor Area = 76 sqft Building Wt. = M lb/sqft

PEOPLE : sqft/person = 0.0 Total People = 0
Schedule No. = 1 Activity Level = 1

LIGHTING : W/sqft = 1.05 Total Watts = 80
Schedule No. = 2 Wattage Mult. = 1.25
Fixture Type = 1 Recessed, not vented

OTHER ELECTRIC: W/sqft = 4.46 Total Watts = 339
Schedule No. = 1

MISC. SENSIBLE: Load = 0 BTU/hr Schedule No. = 1
MISC. LATENT : Load = 0 BTU/hr Schedule No. = 1

6. PARTITIONS, INFILTRATION, GROUND

PARTITIONS (Next to Unconditioned Spaces)	Area (sqft)	U-Value (BTU/hr/sqft/F)	Unconditioned Space Temp. Cooling (deg F or %)	Heating (deg F or %)
Walls	0.0	0.725	90.0 F	55.0 F
Ceilings	0.0	0.100	90.0 F	50.0 F
Floors	0.0	0.082	90.0 F	55.0 F

INFILTRATION			GROUND ELEMENT	
Cooling	: 0.10 CFM/sqft =	8 CFM	Area :	76.0 sqft
Heating	: 0.15 CFM/sqft =	11 CFM	Perimeter :	10.0 ft
Typical	: 0.15 CFM/sqft =	11 CFM	Depth :	10.0 ft

COMPLEX SPACE DESCRIPTION

****

1. SPACE NAME = CORRIDOR BSMT

****

2. WALL INFORMATION (Number of Wall Types = 1)

	Weight (lb/sqft)	Ext Color (D,M,L)	U-Value (BTU/hr/sqft/F)
Wall Type 1	M	D	0.148

Exposure	<-------- Net Wall Areas (sqft) --------> Wall Type 1	Wall Type 2	Wall Type 3
NE	0.0	NA	NA
E	0.0	NA	NA
SE	0.0	NA	NA
S	0.0	NA	NA
SW	0.0	NA	NA
W	0.0	NA	NA
NW	0.0	NA	NA
N	0.0	NA	NA

****

3. ROOF INFORMATION (Number of Roof Types = 1)

	Weight (lb/sqft)	Ext Color (D,M,L)	U-Value (BTU/hr/sqft/F)	Area (sqft)
Roof 1	M	D	0.093	0.0

****

4. GLASS INFORMATION (Number of Glass Types = 1)

	U-Value (BTU/hr/sqft/F)	Glass Factor	Internal Shades
Glass Type 1	0.590	0.65	N

<---------------- External Shading Information ---------------->

	Window Height (ft)	Window Width (ft)	Reveal Depth (in)	Overhang Height (in)	Overhang Extension (in)	Fin Separation (in)	Fin Exten. (in)
Shade 1	7.0	6.0	3.0	84.0	48.0	60.0	48.0
Shade 2	3.0	6.0	3.0	12.0	48.0	12.0	48.0
Shade 3	3.0	6.0	3.0	12.0	48.0	12.0	48.0

****

COMPLEX SPACE DESCRIPTION

Space Name : CORRIDOR BSMT 03-14-94
Prepared By : E.A.C., P.C. Burke, VA 6063092204
Carrier Hourly Analysis Program

4. GLASS INFORMATION (continued)

	Glass Areas (sqft)					
	Type 1		Type 2		Type 3	
Exposure	Area	Shade	Area	Shade	Area	Shade
NE	0.0	0	NA	NA	NA	NA
E	0.0	0	NA	NA	NA	NA
SE	0.0	0	NA	NA	NA	NA
S	0.0	0	NA	NA	NA	NA
SW	0.0	0	NA	NA	NA	NA
W	0.0	0	NA	NA	NA	NA
NW	0.0	0	NA	NA	NA	NA
N	0.0	0	NA	NA	NA	NA
H	0.0	0	NA	NA	NA	NA

5. INTERNAL LOADS

SPACE DATA	: Floor Area	=	100 sqft	Building Wt.	=	M lb/sqft
PEOPLE	: sqft/person	=	24.7	Total People	=	4
	Schedule No.	=	1	Activity Level	=	3
LIGHTING	: W/sqft	=	1.00	Total Watts	=	100
	Schedule No.	=	2	Wattage Mult.	=	1.25
	Fixture Type	=	1 Recessed, not vented			
OTHER ELECTRIC:	W/sqft	=	0.00	Total Watts	=	0
	Schedule No.	=	1			
MISC. SENSIBLE:	Load	=	0 BTU/hr	Schedule No.	=	1
MISC. LATENT	: Load	=	0 BTU/hr	Schedule No.	=	1

6. PARTITIONS, INFILTRATION, GROUND

PARTITIONS (Next to Unconditioned Spaces)	Area (sqft)	U-Value (BTU/hr/sqft/F)	Unconditioned Space Temp. Cooling (deg F or %)	Heating (deg F or %)
Walls	0.0	0.725	90.0 F	55.0 F
Ceilings	0.0	0.100	90.0 F	50.0 F
Floors	0.0	0.082	90.0 F	55.0 F

INFILTRATION			GROUND ELEMENT	
Cooling	: 0.10 CFM/sqft =	10 CFM	Area :	0.0 sqft
Heating	: 0.15 CFM/sqft =	15 CFM	Perimeter :	0.0 ft
Typical	: 0.15 CFM/sqft =	15 CFM	Depth :	0.0 ft

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Base Building Simulation Data

ENERGY BUDGET <A>

Building : #172 AP Hill-Comm. Club — 02-24-94
Site : Fort AP Hill, Virginia — 6063092204
Prepared By : E.A.C., P.C. Burke, VA
Carrier Hourly Analysis Program

TABLE 1. ANNUAL LOADS

Component	(kBTU)	(kBTU/sqft)*
Cooling Loads *	139,774	27.972
Heating Loads *	142,376	28.492

TABLE 2. ENERGY BY SYSTEM COMPONENT

	<----- Site Energy ----->		<---- Source Energy ---->	
Component	(kBTU)	(kBTU/sqft)*	(kBTU)	(kBTU/sqft)*
Air System Fans	94,201	18.852	94,201	18.852
Cooling Plants	58,105	11.628	58,105	11.628
Heating Plants	116,252	23.264	116,252	23.264
Pumps	0	0.000	0	0.000
>> HVAC Total	268,559	53.744	268,559	53.744
Lights	64,051	12.818	64,051	12.818
Other Electric	49,567	9.919	49,567	9.919
Misc. Electric	0	0.000	0	0.000
Dom. Hot Water	55,879	11.182	55,879	11.182
>> Non-HVAC Total	169,497	33.920	169,497	33.920
>> GRAND TOTAL	438,055	87.664	438,055	87.664

* Notes:
1. Site energy is the actual energy consumed.
2. Source energy accounts for electrical generating inefficiencies. For this study:
   Electric generating efficiency =100.0 %
3. Energy per unit floor area is based on the gross building floor area. For this building:
   Gross floor area = 4,997 sqft
   Conditioned floor area = 4,997 sqft
4. Annual cooling load is the sum of all cooling plant loads.
5. Annual heating load is the sum of all primary and auxiliary heating plant loads. It does not include the domestic water heating load.

ENERGY BUDGET <B>

Building : #172 AP Hill-Comm. Club — 02-24-94
Site : Fort AP Hill, Virginia — 6063092204
Prepared By : E.A.C., P.C. Burke, VA
Carrier Hourly Analysis Program —

TABLE 1. ANNUAL LOADS

Component	(kBTU)	(kBTU/sqft)*
Cooling Loads *	139,774	27.972
Heating Loads *	142,376	28.492

TABLE 2. ENERGY BY ENERGY COMPONENT

	<----- Site Energy ----->		<---- Source Energy ---->	
Component	(kBTU)	(kBTU/sqft)*	(kBTU)	(kBTU/sqft)*
Electric	268,559	53.744	268,559	53.744
Natural Gas	0	0.000	0	0.000
Fuel Oil	0	0.000	0	0.000
Propane	0	0.000	0	0.000
Remote Heating	0	0.000	0	0.000
Remote Cooling	0	0.000	0	0.000
>> HVAC Total	268,559	53.744	268,559	53.744
Electric	169,497	33.920	169,497	33.920
Natural Gas	0	0.000	0	0.000
Fuel Oil	0	0.000	0	0.000
Propane	0	0.000	0	0.000
Remote Heating	0	0.000	0	0.000
>> Non-HVAC Total	169,497	33.920	169,497	33.920
>> GRAND TOTAL	438,055	87.664	438,055	87.664

* Notes:
1. Site energy is the actual energy consumed.
2. Source energy accounts for electrical generating inefficiencies. For this study:
   Electric generating efficiency =100.0 %
3. Energy per unit floor area is based on the gross building floor area. For this building:
   Gross floor area = 4,997 sqft
   Conditioned floor area = 4,997 sqft
4. Annual cooling load is the sum of all cooling plant loads.
5. Annual heating load is the sum of all primary and auxiliary heating plant loads. It does not include the domestic water heating load.

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Stand Alone Energy Conservation Opporutnities

[T]he list of ECO's discussed at the interim review meeting were analyzed to determined if any of the ECO's were applicable t[o] [t]he study building. The ECO's listed below are applicable for this study building. Each ECO was simulated as a stand alon[e] [E]CO so that a ranking could be determined based on the ascending order of SIR's and the simple payback periods. If the [S]IR's were greater than 1.25 and the simple payback period was about 10 years for the stand alone ECO , then the ECO was [s]elected for further study and synergistic effects were then taken into account.

[T]he Following ECO's have been arranged according to their SIR's. ECO's with SIR's greater than 1.25, and a simple payback [p]eriod of about 10 years, were then selected for further evaluation (Synergistic Effects). These ECO's only apply to Building [1]72.

Stand Alone ECO's (No Synergistic Effects)

[E]CO	Construction Cost ($)	Annual Energy Savings (Mbtu)	Annual Savings ($)	Simple Payback (Yrs)	SIR
[C]ompact Fluor. Lights	200	4.12	76	2.6	4.49
[E]nergy Saving Fluor. Lamps	300	3.63	67	4.5	2.64
[O]ccupancy Sensors	2,100	17.19	317	6.6	1.79
[W]ater Heater Controls	100	0.50	9	11.1	1.36
[E]xit Sign Retrofit	2,300	14.08	260	8.8	1.34
[D]aylight Dimming Controls	1,200	6.95	128	9.4	1.26
[F]322 T-8 Lighting System	1,600	4.86	89	18.0	0.66
[E]conomizer Controls	10,700	7.06	130	82.3	0.10

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Compact Fluorescent Lights

LIFE CYCLE COST ANALYSIS SUMMARY
WITH SYNERGISTIC EFFECTS

LOCATION: Fort A.P. Hill, Virginia REGION: 3 PROJECT NO.: DACA 31-89-C-0198
PROJECT TITLE: Fort A.P. Hill- Energy Engineering Analysis Program FISCAL YEAR: 1994
DISCRETE PORTION NAME: Compact Fluorescent Lights
ANALYSIS DATE: January 1994 ECONOMIC LIFE (YRS 15 PREPARER: JJS

1. INVESTMENT COSTS:

A. CONSTRUCTION COST	$	200	
B. SIOH	$	11	
C. DESIGN COST	$	12	
D. TOTAL COST (1A+1B+1C)	$	223	
E. SALVAGE VALUE OF EXISTING EQUIPMENT			
F. PUBLIC UTILITY COMPANY REBATE			
G. TOTAL INVESTMENT (1D-1E-1F)			$223

2. ENERGY SAVINGS (+)/COST(-):

DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS- Oct 1992

ENERGY SOURCE	COST $/MBTU(1)	SAVING(S) MBTU/YR(2)	ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELEC	$20.67	4.1	$ 85	11.77	$ 1,002
B. DIST	$5.69		$	13.83	$
C. RESID			$		$
D. NG			$		$
E. LPG	$7.76		$	15.34	$
F. COAL			$		$
G. SOLAR			$		$
H. GEOTH			$		$
I. BIOMA			$		$
J. REFUS			$		$
K. WIND			$		$
L. OTHER			$		$
M. DEMAND SAVINGS			$		$
N. TOTAL		4	$ 85		$ 1,002

3. NON ENERGY SAVINGS (+) OR COST (-):

A. ANNUAL RECURRING (+/-)
(1) DISCOUNT FACTOR (TABLE A)
(2) DISCOUNTED SAVINGS/COST (3A X 3A1)

B. NON RECURRING SAVINGS (+) OR COST (-)

ITEM	SAVINGS(+) COST(-)(1)	YEAR OF OCCUR. (2)	DISCOUNT FACTOR(3)	DISCOUNTED SAV-INGS(+)COST(-)(4)
a.	$			$
b.	$			$
c.	$			$
d. TOTAL				$

C. TOTAL NON ENERGY DISCOUNTED SAVINGS (3A2+3Bd4)

4. SIMPLE PAYBACK 1G/(2N3+3A+(3Bd1/ECONOMIC LIFE)):	2.62 YEARS
5. TOTAL NET DISCOUNTED SAVINGS (2N5+3C):	$1,002
6. SAVINGS TO INVESTMENT RATION (SIR) 5/1G:	4.49
7. ADJUSTED INTERNAL RATE OF RETURN (AIRR):	10.96%

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CONSTRUCTION COST ESTIMATE

PREPARED: March 1994 | SHEET 1 OF 2

PROJECT: Energy Savings Oppurtunity Survey

CONTRACT NO.: DACA 31-89-C-0198

LOCATION: Fort A.P. Hill, Virginia
AE PROJECT NO.: 92008
AE: Engineering Applications Consultants, P.C.

ESTIMATOR: JS | PRELIM:
CHECKED BY: VP | FINAL: X

SUMMARY: Install Compact Fluorescent Lights

ITEM	QUANTITY		MATERIAL		LABOR		TOTAL COST
	NO.	MEAS	UNIT	COST	UNIT	COST	
Building 172							
Replace Incandescent Lighting W/Compact Fl							
15 Watt Compact Fl (LEL15)	2	EA	25.00	50	0.50	1	51
18 Watt Quad Fl. (LCFP18)	4	EA	23.00	92	0.50	2	94
SUB-TOTAL				142		3	145

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CONSTRUCTION COST ESTIMATE

PREPARED: March 1994

PROJECT: Energy Savings Oppurtunity Survey

CONTRACT NO.: DACA 31-89-C-0198

LOCATION: Fort A.P. Hill, Virginia
AE PROJECT NO.:
AE: Engineering Applications Consultants, P.C.

ESTIMATOR: JS
CHECKED BY: VP

PRELIM:
FINAL: X

SUMMARY: Install Compact Fluorescent Lights

ITEM	QUANTITY		MATERIAL		LABOR		TOTAL COST
	NO.	MEAS	UNIT	COST	UNIT	COST	
SUBTOTAL PREVIOUS PAGE				142		3	145
MARK-UP ON LABOR SUB-TOTAL	21.0%			----		1	1 146
TAXES ON MATERIAL SUB-TOTAL	5.0%			7		----	7 153
OVERHEAD SUB-TOTAL	15.0%						23 176
PROFIT SUB-TOTAL	12.0%						21 197
PRIME MARK-UP ON SUB SUB-TOTAL							197
GRAND TOTAL							200

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ENGINEERING ANALYSIS

Sheet ____ of ____

By: JS

Sample Calculation Energy Savings

Project: Fort A. P. Hill ESOS

Date: 2-28-94

Contract No.: DACA 31-89-C-0198

EAC Project No.: 92008

*Base Building Energy Use = 438.055 MBtu/YR

*Building Energy Use with Compact Fluorescent Lights Installed in Building = -433.937 MBtu/YR

Energy Savings 4.118 MBtu/YR

* As simulated with Carrier E20 Building Simulation Program

ENERGY BUDGET <A>

Building : #172-Compact Fluorescent — 02-28-94
Site : Fort AP Hill, Virginia — 6063092204
Prepared By : E.A.C., P.C. Burke, VA
Carrier Hourly Analysis Program —

****

TABLE 1. ANNUAL LOADS

Component	(kBTU)	(kBTU/sqft)*
Cooling Loads *	137,524	27.521
Heating Loads *	143,242	28.666

****

TABLE 2. ENERGY BY SYSTEM COMPONENT

	<----- Site Energy ----->		<---- Source Energy ---->	
Component	(kBTU)	(kBTU/sqft)*	(kBTU)	(kBTU/sqft)*
Air System Fans	94,189	18.849	94,189	18.849
Cooling Plants	57,222	11.451	57,222	11.451
Heating Plants	116,629	23.340	116,629	23.340
Pumps	0	0.000	0	0.000
>> HVAC Total	268,041	53.640	268,041	53.640
Lights	60,450	12.097	60,450	12.097
Other Electric	49,567	9.919	49,567	9.919
Misc. Electric	0	0.000	0	0.000
Dom. Hot Water	55,879	11.182	55,879	11.182
>> Non-HVAC Total	165,896	33.199	165,896	33.199
>> GRAND TOTAL	433,937	86.840	433,937	86.840

* Notes:
1. Site energy is the actual energy consumed.
2. Source energy accounts for electrical generating inefficiencies. For this study:
   Electric generating efficiency =100.0 %
3. Energy per unit floor area is based on the gross building floor area. For this building:
   Gross floor area = 4,997 sqft
   Conditioned floor area = 4,997 sqft
4. Annual cooling load is the sum of all cooling plant loads.
5. Annual heating load is the sum of all primary and auxiliary heating plant loads. It does not include the domestic water heating load.

****

ENERGY BUDGET <B>

Building : #172-Compact Fluorescent
Site : Fort AP Hill, Virginia
Prepared By : E.A.C., P.C. Burke, VA
Carrier Hourly Analysis Program

02-28-94
6063092204

****

TABLE 1. ANNUAL LOADS

Component	(kBTU)	(kBTU/sqft)*
Cooling Loads *	137,524	27.521
Heating Loads *	143,242	28.666

****

TABLE 2. ENERGY BY ENERGY COMPONENT

Component	<----- Site Energy -----> (kBTU)	(kBTU/sqft)*	<---- Source Energy ----> (kBTU)	(kBTU/sqft)*
Electric	268,041	53.640	268,041	53.640
Natural Gas	0	0.000	0	0.000
Fuel Oil	0	0.000	0	0.000
Propane	0	0.000	0	0.000
Remote Heating	0	0.000	0	0.000
Remote Cooling	0	0.000	0	0.000
>> HVAC Total	268,041	53.640	268,041	53.640
Electric	165,896	33.199	165,896	33.199
Natural Gas	0	0.000	0	0.000
Fuel Oil	0	0.000	0	0.000
Propane	0	0.000	0	0.000
Remote Heating	0	0.000	0	0.000
>> Non-HVAC Total	165,896	33.199	165,896	33.199
>> GRAND TOTAL	433,937	86.840	433,937	86.840

* Notes:
1. Site energy is the actual energy consumed.
2. Source energy accounts for electrical generating inefficiencies. For this study:
   Electric generating efficiency =100.0 %
3. Energy per unit floor area is based on the gross building floor area. For this building:
   Gross floor area = 4,997 sqft
   Conditioned floor area = 4,997 sqft
4. Annual cooling load is the sum of all cooling plant loads.
5. Annual heating load is the sum of all primary and auxiliary heating plant loads. It does not include the domestic water heating load.

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EAC STANDARD FORM
JULY 1985

ENGINEERING ANALYSIS

Sheet 1 of 1

By: M. SCHRAM

REPLACE INCAND. W/ COMPACT FLUOR.

Project: FORT A.P. HILL ESOS Date: 2-26-94

Contract No.: DACA 31-89-C-0198 EAC Project No.: 92008.00

FIXTURE	INCANDESCENT WATTAGE (TOTAL)	COMPACT FLUORESCENT WATTAGE (TOTAL)
RECESSED, CEILING MOUNTED, DOWNLIGHT	60 W	15 W
	75 W	20 W
	100 W	27 W
WALL MOUNTED, 2-LAMP FIXTURE	2 x 90 = 180 W	2 x 27 W = 54 W

CF LAMP REPLACEMENTS TO OCCUR EVERY 10,000 HOURS.
INCANDESCENTS ARE REPLACED EVERY 1,000 HOURS.

FIXTURES ON DIMMER CIRCUITS SHALL NOT BE INCLUDED.

Energy Savings Fluorescent Lamps

LIFE CYCLE COST ANALYSIS SUMMARY
WITH SYNERGISTIC EFFECTS

LOCATION: Fort A.P. Hill, Virginia REGION: 3 PROJECT NO.: DACA 31-89-C-0198
PROJECT TITLE: Fort A.P. Hill- Energy Engineering Analysis Program FISCAL YEAR: 1994
DISCRETE PORTION NAME: Energy Savings Fluorescent Lamps
ANALYSIS DATE: January 1994 ECONOMIC LIFE (YRS 15 PREPARER: JJS

1. INVESTMENT COSTS:

A. CONSTRUCTION COST	$	300	
B. SIOH	$	17	
C. DESIGN COST	$	18	
D. TOTAL COST (1A+1B+1C)	$	335	
E. SALVAGE VALUE OF EXISTING EQUIPMENT			
F. PUBLIC UTILITY COMPANY REBATE			
G. TOTAL INVESTMENT (1D-1E-1F)			$335

2. ENERGY SAVINGS (+)/COST(-):

DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS- Oct 1992

ENERGY SOURCE	COST $/MBTU(1)	SAVING(S) MBTU/YR(2)	ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELEC	$20.67	3.7	$ 76	11.77	$ 895
B. DIST	$5.69		$	13.83	$
C. RESID			$		$
D. NG			$		$
E. LPG	$7.76		$	15.34	$
F. COAL			$		$
G. SOLAR			$		$
H. GEOTH			$		$
I. BIOMA			$		$
J. REFUS			$		$
K. WIND			$		$
L. OTHER			$		$
M. DEMAND SAVINGS			$		$
N. TOTAL		4	$ 76		$ 895

3. NON ENERGY SAVINGS (+) OR COST (-):

A. ANNUAL RECURRING (+/-)
(1) DISCOUNT FACTOR (TABLE A)
(2) DISCOUNTED SAVINGS/COST (3A X 3A1)

B. NON RECURRING SAVINGS (+) OR COST (-)

ITEM	SAVINGS(+) COST(-)(1)	YEAR OF OCCUR. (2)	DISCOUNT FACTOR(3)	DISCOUNTED SAVINGS(+)COST(-)(4)
a.	$			$
b.	$			$
c.	$			$
d. TOTAL				$

C. TOTAL NON ENERGY DISCOUNTED SAVINGS (3A2+3Bd4)

4. SIMPLE PAYBACK 1G/(2N3+3A+(3Bd1/ECONOMIC LIFE)): 4.40 YEARS
5. TOTAL NET DISCOUNTED SAVINGS (2N5+3C): $895
6. SAVINGS TO INVESTMENT RATION (SIR) 5/1G: 2.68
7. ADJUSTED INTERNAL RATE OF RETURN (AIRR): 7.05%

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CONSTRUCTION COST ESTIMATE	PREPARED: March 1994 SHEET 1 OF 2
PROJECT: Energy Savings Oppurtunity Survey LOCATION: Fort A.P. Hill, Virginia AE PROJECT NO.: 92008 AE: Engineering Applications Consultants, P.C.	CONTRACT NO.: DACA 31-89-C-0198 ESTIMATOR: JS PRELIM: CHECKED BY: VP FINAL: X

SUMMARY: Energy Saving Fluor. Lamps

ITEM	QUANTITY		MATERIAL		LABOR		TOTAL COST
	NO.	MEAS	UNIT	COST	UNIT	COST	
Building 172 Install 35 Watt Energy Saving Fluor. Lamps	38	EA	3.45	131	1.50	57	188
SUB-TOTAL				131		57	188

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CONSTRUCTION COST ESTIMATE	PREPARED: March 1994	SHEET 2 OF 2
PROJECT: Energy Savings Oppurtunity Survey	CONTRACT NO.: DACA 31-89-C-0198	
LOCATION: Fort A.P. Hill, Virginia		
AE PROJECT NO.:	ESTIMATOR: JS	PRELIM:
AE: Engineering Applications Consultants, P.C.	CHECKED BY: VP	FINAL: X

SUMMARY: Energy Saving Fluor. Lamps

ITEM	QUANTITY		MATERIAL		LABOR		TOTAL COST
	NO.	MEAS	UNIT	COST	UNIT	COST	
SUBTOTAL PREVIOUS PAGE				131		57	188
MARK-UP ON LABOR SUB-TOTAL	21.0%			—		12	12 200
TAXES ON MATERIAL SUB-TOTAL	5.0%			7		—	7 207
OVERHEAD SUB-TOTAL	15.0%						31 237
PROFIT SUB-TOTAL	12.0%						28 266
PRIME MARK-UP ON SUB SUB-TOTAL							266
GRAND TOTAL							300

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ENGINEERING ANALYSIS

Sheet ____ of ____

By: JS

Sample Calculation - Energy Savings

Project: Fort A. P. Hill ESOS

Date: 2-28-94

Contract No.: DACA 31-89-C-0198

EAC Project No.: 92008

Building w/ Compact Fluorescent Lights Installed Becomes Base Building — 433.97 MBtu/yr

Building With Compact Fluorescent Lights And 34 Watt Energy Saving Fluorescent Lamps Installed — −430.254 MBtu/yr

Energy Savings = 3.7 MBtu/yr

ENERGY BUDGET <A>

Building : #172-Comp.Fl w/ 34w Lamp
Site : Fort AP Hill, Virginia
Prepared By : E.A.C., P.C. Burke, VA
Carrier Hourly Analysis Program

03-01-94
6063092204

****

TABLE 1. ANNUAL LOADS

Component	(kBTU)	(kBTU/sqft)*
Cooling Loads *	136,057	27.228
Heating Loads *	143,431	28.703

****

TABLE 2. ENERGY BY SYSTEM COMPONENT

	<----- Site Energy ----->		<---- Source Energy ---->	
Component	(kBTU)	(kBTU/sqft)*	(kBTU)	(kBTU/sqft)*
Air System Fans	94,234	18.858	94,234	18.858
Cooling Plants	56,578	11.322	56,578	11.322
Heating Plants	116,712	23.356	116,712	23.356
Pumps	0	0.000	0	0.000
>> HVAC Total	267,524	53.537	267,524	53.537
Lights	57,284	11.464	57,284	11.464
Other Electric	49,567	9.919	49,567	9.919
Misc. Electric	0	0.000	0	0.000
Dom. Hot Water	55,879	11.182	55,879	11.182
>> Non-HVAC Total	162,730	32.566	162,730	32.566
>> GRAND TOTAL	430,254	86.102	430,254	86.102

* Notes:
1. Site energy is the actual energy consumed.
2. Source energy accounts for electrical generating inefficiencies. For this study:
   Electric generating efficiency =100.0 %
3. Energy per unit floor area is based on the gross building floor area. For this building:
   Gross floor area = 4,997 sqft
   Conditioned floor area = 4,997 sqft
4. Annual cooling load is the sum of all cooling plant loads.
5. Annual heating load is the sum of all primary and auxiliary heating plant loads. It does not include the domestic water heating load.

****

Building : #172-Comp.Fl w/ 34w Lamp — 03-01-94
Site : Fort AP Hill, Virginia — 6063092204
Prepared By : E.A.C., P.C. Burke, VA
Carrier Hourly Analysis Program —

TABLE 1. ANNUAL LOADS

Component	(kBTU)	(kBTU/sqft)*
Cooling Loads *	136,057	27.228
Heating Loads *	143,431	28.703

TABLE 2. ENERGY BY ENERGY COMPONENT

Component	Site Energy (kBTU)	Site Energy (kBTU/sqft)*	Source Energy (kBTU)	Source Energy (kBTU/sqft)*
Electric	267,524	53.537	267,524	53.537
Natural Gas	0	0.000	0	0.000
Fuel Oil	0	0.000	0	0.000
Propane	0	0.000	0	0.000
Remote Heating	0	0.000	0	0.000
Remote Cooling	0	0.000	0	0.000
>> HVAC Total	267,524	53.537	267,524	53.537
Electric	162,730	32.566	162,730	32.566
Natural Gas	0	0.000	0	0.000
Fuel Oil	0	0.000	0	0.000
Propane	0	0.000	0	0.000
Remote Heating	0	0.000	0	0.000
>> Non-HVAC Total	162,730	32.566	162,730	32.566
>> GRAND TOTAL	430,254	86.102	430,254	86.102

* Notes:
1. Site energy is the actual energy consumed.
2. Source energy accounts for electrical generating inefficiencies. For this study:
   Electric generating efficiency =100.0 %
3. Energy per unit floor area is based on the gross building floor area. For this building:
   Gross floor area = 4,997 sqft
   Conditioned floor area = 4,997 sqft
4. Annual cooling load is the sum of all cooling plant loads.
5. Annual heating load is the sum of all primary and auxiliary heating plant loads. It does not include the domestic water heating load.

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EAC STANDARD FORM
JULY 1985

ENGINEERING ANALYSIS

Sheet 1 of 1

By: K. SCHRAM

REPLACE FLUORESCENT LAMPS (OR FIXTURES)

Project: FORT A.P. HILL ESOS Date: 2-26-94

Contract No.: DACA 31-89-C-0198 EAC Project No.: 92008.00

STANDARD 1x4 FLUORESCENT FIXTURES W/ 2@40W EA. LAMPS (F40T-12)
1 BALLAST

A) REPLACE LAMPS ONLY W/ 34W (F30T-12)
ENERGY SAVERS

POWER SAVINGS PER FIXTURE = $40(2) - 34(2) = 12$ WATTS

OR $\frac{12}{40(2)} = 15\%$

B) • REPLACE F40T12 LAMPS WITH F32T-8 LAMPS.
• REPLACE EXISTING BALLAST WITH ELECTRONIC "T-8" BALLAST.
(ONE PER FIXTURE FOR 2 LAMPS PER BALLAST)
• REUSE EXISTING FIXTURE HOUSING.

POWER SAVINGS PER FIXTURE = $40(2) - 32(2) = 16$ WATTS

OR $\frac{16}{40(2)} = 20\%$

Occupancy Sensors

LIFE CYCLE COST ANALYSIS SUMMARY
WITH SYNERGISTIC EFFECTS

LOCATION: Fort A.P. Hill, Virginia   REGION: 3   PROJECT NO.: DACA 31-89-C-0198
PROJECT TITLE: Fort A.P. Hill- Energy Engineering Analysis Program   FISCAL YEAR: 1994
DISCRETE PORTION NAME: Occupancy Sensors
ANALYSIS DATE: January 1994   ECONOMIC LIFE (YRS 15   PREPARER: JJS

1. INVESTMENT COSTS:

A. CONSTRUCTION COST	$	2,100	
B. SIOH	$	116	
C. DESIGN COST	$	126	
D. TOTAL COST (1A+1B+1C)	$	2,342	
E. SALVAGE VALUE OF EXISTING EQUIPMENT			
F. PUBLIC UTILITY COMPANY REBATE			
G. TOTAL INVESTMENT (1D-1E-1F)			$2,342

2. ENERGY SAVINGS (+)/COST(-):

DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS- Oct 1992

ENERGY SOURCE	COST $/MBTU(1)	SAVING(S) MBTU/YR(2)	ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELEC	$20.67	15.5	$ 320	11.77	$ 3,761
B. DIST	$5.69		$	13.83	$
C. RESID			$		$
D. NG			$		$
E. LPG	$7.76		$	15.34	$
F. COAL			$		$
G. SOLAR			$		$
H. GEOTH			$		$
I. BIOMA			$		$
J. REFUS			$		$
K. WIND			$		$
L. OTHER			$		$
M. DEMAND SAVINGS			$		$
N. TOTAL		15	$ 320		$ 3,761

3. NON ENERGY SAVINGS (+) OR COST (-):

A. ANNUAL RECURRING (+/-)
(1) DISCOUNT FACTOR (TABLE A)
(2) DISCOUNTED SAVINGS/COST (3A X 3A1)

B. NON RECURRING SAVINGS (+) OR COST (-)

ITEM	SAVINGS(+) COST(-)(1)	YEAR OF OCCUR. (2)	DISCOUNT FACTOR(3)	DISCOUNTED SAVINGS(+)COST(-)(4)
a.	$			$
b.	$			$
c.	$			$
d. TOTAL				$

C. TOTAL NON ENERGY DISCOUNTED SAVINGS (3A2+3Bd4)

4. SIMPLE PAYBACK 1G/(2N3+3A+(3Bd1/ECONOMIC LIFE)):	7.33 YEARS
5. TOTAL NET DISCOUNTED SAVINGS (2N5+3C):	$3,761
6. SAVINGS TO INVESTMENT RATION (SIR) 5/1G:	1.61
7. ADJUSTED INTERNAL RATE OF RETURN (AIRR):	3.34%

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CONSTRUCTION COST ESTIMATE

PREPARED: March 1994 SHEET 1 OF 2

PROJECT: Energy Savings Oppurtunity Survey

CONTRACT NO.: DACA 31-89-C-0198

LOCATION: Fort A.P. Hill, Virginia
AE PROJECT NO.: 92008
AE: Engineering Applications Consultants, P.C.

ESTIMATOR: JS
CHECKED BY: VP

PRELIM:
FINAL: X

SUMMARY: Occupancy Sensors

ITEM	QUANTITY		MATERIAL		LABOR		TOTAL
	NO.	MEAS	UNIT	COST	UNIT	COST	COST
Building 172							
Motion Sensors- Infrared Wall Switch	15	EA	77.00	1,155	7.00	105	1,260
Conduit, non-metallic, 1/2"	100	LF	0.44	44	1.10	110	154
Wire, 600v type THWN, #12	1	CLF	5.90	6	19.00	19	25
Outlet Box, non-metallic, 4"	6	EA	1.40	8	8.35	50	58
SUB-TOTAL				1,213		284	1,497

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CONSTRUCTION COST ESTIMATE

PREPARED: March 1994 SHEET OF

SHEET 2 OF 2

PROJECT: Energy Savings Oppurtunity Survey

CONTRACT NO.: DACA 31-89-C-0198

LOCATION: Fort A.P. Hill, Virginia

AE PROJECT NO.:

AE: Engineering Applications Consultants, P.C.

ESTIMATOR: JS PRELIM:

CHECKED BY: VP FINAL: X

SUMMARY: Occupancy Sensors

ITEM	QUANTITY NO.	QUANTITY MEAS	MATERIAL UNIT	MATERIAL COST	LABOR UNIT	LABOR COST	TOTAL COST
SUBTOTAL PREVIOUS PAGE				1,213		284	1,497
MARK-UP ON LABOR SUB-TOTAL	21.0%			—		60	60 1,557
TAXES ON MATERIAL SUB-TOTAL	5.0%			61		—	61 1,617
OVERHEAD SUB-TOTAL	15.0%						243 1,860
PROFIT SUB-TOTAL	12.0%						223 2,083
PRIME MARK-UP ON SUB SUB-TOTAL							2,083
GRAND TOTAL							2,100

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ENGINEERING ANALYSIS

Sheet ____ of ____

By: JS

Sample Calculation - Energy Savings

Project: Fort A. P. Hill ESOS

Date: 2-28-94

Contract No.: DACA 31-89-C-0198

EAC Project No.: 92008

Building Energy Use w/ Compact Fluor. Lights, 34 Watt Energy Saving Fluor. Lamps — 430.254 MBtu/yr

Building Energy Use w/ Occupancy Sensors, Compact Fluor. Lights, and 34 Watt Energy Saving Fluorescent Lamps — 414.790 MBtu/yr

Energy Savings = 15.5 MBtu/yr

ENERGY BUDGET <A>

Building : #172-Oc.Sen w/CF&34wLamp 03-01-94
Site : Fort AP Hill, Virginia 6063092204
Prepared By : E.A.C., P.C. Burke, VA
Carrier Hourly Analysis Program

TABLE 1. ANNUAL LOADS

Component	(kBTU)	(kBTU/sqft)*
Cooling Loads *	128,495	25.714
Heating Loads *	148,181	29.654

TABLE 2. ENERGY BY SYSTEM COMPONENT

Component	<----- Site Energy -----> (kBTU)	(kBTU/sqft)*	<---- Source Energy ----> (kBTU)	(kBTU/sqft)*
Air System Fans	93,902	18.792	93,902	18.792
Cooling Plants	53,450	10.697	53,450	10.697
Heating Plants	118,731	23.761	118,731	23.761
Pumps	0	0.000	0	0.000
>> HVAC Total	266,083	53.249	266,083	53.249
Lights	43,261	8.657	43,261	8.657
Other Electric	49,567	9.919	49,567	9.919
Misc. Electric	0	0.000	0	0.000
Dom. Hot Water	55,879	11.182	55,879	11.182
>> Non-HVAC Total	148,707	29.759	148,707	29.759
>> GRAND TOTAL	414,790	83.008	414,790	83.008

* Notes:
1. Site energy is the actual energy consumed.
2. Source energy accounts for electrical generating inefficiencies. For this study:
   Electric generating efficiency =100.0 %
3. Energy per unit floor area is based on the gross building floor area. For this building:
   Gross floor area = 4,997 sqft
   Conditioned floor area = 4,997 sqft
4. Annual cooling load is the sum of all cooling plant loads.
5. Annual heating load is the sum of all primary and auxiliary heating plant loads. It does not include the domestic water heating load.

ENERGY BUDGET <B>

Building : #172-Oc.Sen w/CF&34wLamp 03-01-94
Site : Fort AP Hill, Virginia 6063092204
Prepared By : E.A.C., P.C. Burke, VA
Carrier Hourly Analysis Program

TABLE 1. ANNUAL LOADS

Component	(kBTU)	(kBTU/sqft)*
Cooling Loads *	128,495	25.714
Heating Loads *	148,181	29.654

TABLE 2. ENERGY BY ENERGY COMPONENT

	<----- Site Energy ----->		<---- Source Energy ---->	
Component	(kBTU)	(kBTU/sqft)*	(kBTU)	(kBTU/sqft)*
Electric	266,083	53.249	266,083	53.249
Natural Gas	0	0.000	0	0.000
Fuel Oil	0	0.000	0	0.000
Propane	0	0.000	0	0.000
Remote Heating	0	0.000	0	0.000
Remote Cooling	0	0.000	0	0.000
>> HVAC Total	266,083	53.249	266,083	53.249
Electric	148,707	29.759	148,707	29.759
Natural Gas	0	0.000	0	0.000
Fuel Oil	0	0.000	0	0.000
Propane	0	0.000	0	0.000
Remote Heating	0	0.000	0	0.000
>> Non-HVAC Total	148,707	29.759	148,707	29.759
>> GRAND TOTAL	414,790	83.008	414,790	83.008

* Notes:
1. Site energy is the actual energy consumed.
2. Source energy accounts for electrical generating inefficiencies. For this study:
   Electric generating efficiency =100.0 %
3. Energy per unit floor area is based on the gross building floor area. For this building:
   Gross floor area = 4,997 sqft
   Conditioned floor area = 4,997 sqft
4. Annual cooling load is the sum of all cooling plant loads.
5. Annual heating load is the sum of all primary and auxiliary heating plant loads. It does not include the domestic water heating load.

Shut Down Energy to Hotwater Heaters or Modify Controls

LIFE CYCLE COST ANALYSIS SUMMARY
WITH SYNERGISTIC EFFECTS

LOCATION: Fort A.P. Hill, Virginia REGION: 3 PROJECT NO.: DACA 31-89-C-0198
PROJECT TITLE: Fort A.P. Hill- Energy Engineering Analysis Program FISCAL YEAR: 1994
DISCRETE PORTION NAME: Shut Down Energy To Hotwater Heaters or Modify Controls
ANALYSIS DATE: January 1994 ECONOMIC LIFE (YRS 20 PREPARER: JJS

1. INVESTMENT COSTS:

A. CONSTRUCTION COST	$	100	
B. SIOH	$	6	
C. DESIGN COST	$	6	
D. TOTAL COST (1A+1B+1C)	$	112	
E. SALVAGE VALUE OF EXISTING EQUIPMENT			
F. PUBLIC UTILITY COMPANY REBATE			
G. TOTAL INVESTMENT (1D-1E-1F)			$112

2. ENERGY SAVINGS (+)/COST(-):

DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS- Oct 1992

ENERGY SOURCE	COST $/MBTU(1)	SAVING(S) MBTU/YR(2)		ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)		DISCOUNTED SAVINGS(5)
A. ELEC	$20.67	0.5	$	10	14.65	$	151
B. DIST	$5.69		$		17.70	$	
C. RESID			$			$	
D. NG			$			$	
E. LPG	$7.76		$		20.60	$	
F. COAL			$			$	
G. SOLAR			$			$	
H. GEOTH			$			$	
I. BIOMA			$			$	
J. REFUS			$			$	
K. WIND			$			$	
L. OTHER			$			$	
M. DEMAND SAVINGS			$			$	
N. TOTAL		1	$	10		$	151

3. NON ENERGY SAVINGS (+) OR COST (-):

A. ANNUAL RECURRING (+/-)
(1) DISCOUNT FACTOR (TABLE A)
(2) DISCOUNTED SAVINGS/COST (3A X 3A1)

B. NON RECURRING SAVINGS (+) OR COST (-)

ITEM		SAVINGS(+) COST(-)(1)	YEAR OF OCCUR. (2)	DISCOUNT FACTOR(3)		DISCOUNTED SAVINGS(+)COST(-)(4)
a.	$				$	
b.	$				$	
c.	$				$	
d. TOTAL					$	

C. TOTAL NON ENERGY DISCOUNTED SAVINGS (3A2+3Bd4)

4. SIMPLE PAYBACK 1G/(2N3+3A+(3Bd1/ECONOMIC LIFE)):	10.79 YEARS
5. TOTAL NET DISCOUNTED SAVINGS (2N5+3C):	$151
6. SAVINGS TO INVESTMENT RATION (SIR) 5/1G:	1.36
7. ADJUSTED INTERNAL RATE OF RETURN (AIRR):	1.60%

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CONSTRUCTION COST ESTIMATE

PREPARED: March 1994 | SHEET 1 OF 2

PROJECT: Energy Savings Oppurtunity Survey

CONTRACT NO.: DACA 31-89-C-0198

LOCATION: Fort A.P. Hill, Virginia
AE PROJECT NO.: 92008
AE: Engineering Applications Consultants, P.C.

ESTIMATOR: JS | PRELIM:
CHECKED BY: VP | FINAL: X

SUMMARY: Shut Down Energy to Hotwater Heaters or Modify Controls

ITEM	QUANTITY		MATERIAL		LABOR		TOTAL COST
	NO.	MEAS	UNIT	COST	UNIT	COST	
Building 172							
Water Heater Timer	1	EA	40.00	40	18.25	18	58
SUB-TOTAL				40		18	58

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CONSTRUCTION COST ESTIMATE	PREPARED: March 1994	SHEET 2 OF 2
PROJECT: Energy Savings Oppurtunity Survey	CONTRACT NO.: DACA 31-89-C-0198	
LOCATION: Fort A.P. Hill, Virginia		
AE PROJECT NO.:	ESTIMATOR: JS	PRELIM:
AE: Engineering Applications Consultants, P.C.	CHECKED BY: VP	FINAL: X

SUMMARY: Shut Down Energy to Hotwater Heaters or Modify Controls

ITEM	QUANTITY		MATERIAL		LABOR		TOTAL COST
	NO.	MEAS	UNIT	COST	UNIT	COST	
SUBTOTAL PREVIOUS PAGE				40		18	58
MARK-UP ON LABOR	21.0%			—		4	4
SUB-TOTAL							62
TAXES ON MATERIAL	5.0%			2		—	2
SUB-TOTAL							64
OVERHEAD	15.0%						10
SUB-TOTAL							73
PROFIT	12.0%						9
SUB-TOTAL							82
PRIME MARK-UP ON SUB							
SUB-TOTAL							82
GRAND TOTAL							100

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Water Heater Controls- Install Timer to turn heater off during unoccupied periods

Heater Eff.=	100%	(electric)
Tank Capacity	167	Gallons
Utank=	0.22	Btu/F*Ft**2*Hr
Atank=	50	Ft**2
Ttank=	140	deg. F
Tsurroundings=	65	deg. F

Hour	Tank Temp F	Heat Lost per Hour (Btu's/Hr)	Total Heat Lost (Btu's)
0	140.0	825.0	
			814.5
1	138.1	804.1	
			793.9
2	136.2	783.7	
			773.7
3	134.4	763.8	
			754.1
4	132.7	744.4	
			735.0
5	131.0	725.5	
			716.3
6	129.3	707.1	
			698.2
7	127.7	689.2	
			680.5
8	126.1	671.7	
			663.2
9	124.5	654.7	
			646.4
10	123.0	638.1	
			630.0
11	121.5	621.9	
			614.0
12	120.1	606.1	
Total Heat Lost (Btu's Required to Return Water to 140F) =			(8,519.8)

Total Energy Required to Maintain 140F throughout 12 hour period=	9,900.0	Btu's
Total Energy Required to Return Water to 140F=	(8,519.8)	Btu's
Total Energy Saved per Day (Btu's)=	1,380.2	Btu's/Day
Total Energy Saved per Year=	0.504	MBtu's/Yr

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EAC STANDARD FORM
JULY 1985

ENGINEERING ANALYSIS

Sheet 1 of 3

By: K. SCHRAM

WATER HEATER TIMER

Project: FORT A.P. HILL ESOS Date: 2-23-94

Contract No.: DACA 31-89-C-0198 EAC Project No.: 92008.00

BLDG. 172:

ESTIMATE TANK SIZE BASED ON CRITERIA OF ARMY TM 5-810-5, CHAPTER 4.

USE = DISHWASHING → G = 10 GPD, B = 10 HRS, D = 5 HRS
N = 125 PEOPLE, ELEMENT = 54 kW
(184 kBTU/HR)

$$A = \frac{(10\ \text{GPD})(125)}{10\ \text{HRS}} = 125\ \text{GPH AVG.}$$

$$P = \frac{(10\ \text{GPD})(125)}{5\ \text{HRS}} = 250\ \text{GPH PEAK}$$

$$S = \text{STORAGE} = \frac{250-125}{0.75} = \boxed{167\ \text{GALLONS}}$$

$$R = \text{RECOVERY} = \frac{DP - S}{D} = \frac{5(250)-167}{5} = 217\ \text{GPH}$$

$$\text{HEAT REQUIREMENT} = \frac{(500)\left(\frac{R}{60}\right)(140^\circ - 40^\circ)}{1000} = 181\ \text{kBTU/HR}$$

(CORRESPONDS TO INSTALLED CAPACITY THEREFORE STORAGE ESTIMATE IS VALID.)

Engineering
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EAC STANDARD FORM
JULY 1985

ENGINEERING ANALYSIS

Sheet 2 of 3

By: K. SCHRAM

WATER HEATER TIMER

Project: FORT A.P. HILL ESDS Date: 2-23-94

Contract No.: DACA 31-89-C-0198 EAC Project No.: 92008.00

EQUIPMENT: 167 GALLON TANK, 54.0 KW INPUT
(30"Ø, 60"H) ⇒ 50 FT^2 SURFACE AREA

ECO:
INSTALL TIMER ON HEATER SO THAT UNIT OPERATES DURING OCCUPIED HOURS TO REDUCE NIGHT STANDBY LOSSES.

COST: CLOCK DIAL TIME SWITCH, 24-HOUR
W/ ENCLOSURE AND TYPE NM CABLE
MATERIAL = $40
LABOR = $20

ANNUAL ENERGY SAVINGS = 0.504 MBTU/YEAR
(SEE NEXT PAGE)

UTILIZING AN "OFF" PERIOD FROM 9:00PM TO 7:00 AM.

AT A RATE OF $18.464/MBTU ANNUAL ELECTRIC RATE,

(0.504 MBTU/YEAR)($18.464/MBTU) = $9.31/YEAR SAVINGS

Exit Sign Retrofit

LIFE CYCLE COST ANALYSIS SUMMARY
WITH SYNERGISTIC EFFECTS

LOCATION: Fort A.P. Hill, Virginia REGION: 3 PROJECT NO.: DACA 31-89-C-0198
PROJECT TITLE: Fort A.P. Hill- Energy Engineering Analysis Program FISCAL YEAR: 1994
DISCRETE PORTION NAME: Exit Sign Retrofit
ANALYSIS DATE: January 1994 ECONOMIC LIFE (YRS 15 PREPARER: JJS

1. INVESTMENT COSTS:

A. CONSTRUCTION COST	$	2,300	
B. SIOH	$	127	
C. DESIGN COST	$	138	
D. TOTAL COST (1A+1B+1C)	$	2,565	
E. SALVAGE VALUE OF EXISTING EQUIPMENT			
F. PUBLIC UTILITY COMPANY REBATE			
G. TOTAL INVESTMENT (1D-1E-1F)			$2,565

2. ENERGY SAVINGS (+)/COST(-):

DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS- Oct 1992

ENERGY SOURCE	COST $/MBTU(1)	SAVING(S) MBTU/YR(2)	ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELEC	$20.67	14.1	$ 291	11.77	$ 3,425
B. DIST	$5.69		$	13.83	$
C. RESID			$		$
D. NG			$		$
E. LPG	$7.76		$	15.34	$
F. COAL			$		$
G. SOLAR			$		$
H. GEOTH			$		$
I. BIOMA			$		$
J. REFUS			$		$
K. WIND			$		$
L. OTHER			$		$
M. DEMAND SAVINGS			$		$
N. TOTAL		14	$ 291		$ 3,425

3. NON ENERGY SAVINGS (+) OR COST (-):

A. ANNUAL RECURRING (+/-)
(1) DISCOUNT FACTOR (TABLE A)
(2) DISCOUNTED SAVINGS/COST (3A X 3A1)

B. NON RECURRING SAVINGS (+) OR COST (-)

ITEM	SAVINGS(+) COST(-)(1)	YEAR OF OCCUR. (2)	DISCOUNT FACTOR(3)	DISCOUNTED SAVINGS(+)COST(-)(4)
a.	$			$
b.	$			$
c.	$			$
d. TOTAL				$

C. TOTAL NON ENERGY DISCOUNTED SAVINGS (3A2+3Bd4)

4. SIMPLE PAYBACK 1G/(2N3+3A+(3Bd1/ECONOMIC LIFE)):	8.81 YEARS
5. TOTAL NET DISCOUNTED SAVINGS (2N5+3C):	$3,425
6. SAVINGS TO INVESTMENT RATION (SIR) 5/1G:	1.34
7. ADJUSTED INTERNAL RATE OF RETURN (AIRR):	2.03%

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CONSTRUCTION COST ESTIMATE

CONSTRUCTION COST ESTIMATE	PREPARED: March 1994 SHEET 1 OF 2
PROJECT: Energy Savings Oppurtunity Survey	CONTRACT NO.: DACA 31-89-C-0198
LOCATION: Fort A.P. Hill, Virginia	
AE PROJECT NO.: 92008	ESTIMATOR: JS PRELIM:
AE: Engineering Applications Consultants, P.C.	CHECKED BY: VP FINAL: X

SUMMARY: Exit Sign Retrofit

ITEM	QUANTITY		MATERIAL		LABOR		TOTAL
	NO.	MEAS	UNIT	COST	UNIT	COST	COST
Building 172 Battery Backup LED Exit Sign Replacement Fixtures	11	EA	125.00	1,375	25.00	275	1,650
SUB-TOTAL				1,375		275	1,650

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CONSTRUCTION COST ESTIMATE

PREPARED: March 1994 SHEET 2 OF 2

PROJECT: Energy Savings Oppurtunity Survey

CONTRACT NO.: DACA 31-89-C-0198

LOCATION: Fort A.P. Hill, Virginia
AE PROJECT NO.:
AE: Engineering Applications Consultants, P.C.

ESTIMATOR: JS PRELIM:
CHECKED BY: VP FINAL: X

SUMMARY: Exit Sign Retrofit

ITEM	QUANTITY NO.	QUANTITY MEAS	MATERIAL UNIT	MATERIAL COST	LABOR UNIT	LABOR COST	TOTAL COST
SUBTOTAL PREVIOUS PAGE				1,375		275	1,650
MARK-UP ON LABOR SUB-TOTAL	21.0%			—		58	58 1,708
TAXES ON MATERIAL SUB-TOTAL	5.0%			69		—	69 1,777
OVERHEAD SUB-TOTAL	15.0%						266 2,043
PROFIT SUB-TOTAL	12.0%						245 2,288
PRIME MARK-UP ON SUB SUB-TOTAL							2,288
GRAND TOTAL							2,300

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EAC STANDARD FORM
JULY 1985

ENGINEERING ANALYSIS

Sheet 1 of 1

By: M. SCHRAM

"L.E.D" EXIT SIGNS

Project: FORT A.P. HILL ESOS Date: 2-26-94

Contract No.: DACA 31-89-C-0198 EAC Project No.: 92008.00

EXISTING SIGNS HAVE 25 WATT LIGHT SOURCE. (1.0 BALLAST FACTOR)

REPLACEMENT SIGNS HAVE 6 WATT LIGHT SOURCE. (1.2 BALLAST FACTOR)

POWER SAVINGS PER REPLACEMENT = (2)25(1) - 6(1.2)
= 42.8 WATTS

LAMP LIFE OF "LED" SIGNS IS ESTIMATED BY THE MANUFACTURER (REF. CHLORIDE SYSTEMS, INC.) AT 30(+) YEARS.

ENERGY SAVINGS PER YEAR = $4123.9 \text{ KWH} \times \frac{3.413 \text{ kBtu/hr}}{1 \text{ kW}}$

$= 14{,}075 \text{ kBtu} = 14.075 \text{ MBTU}$

LIGHTING CALCULATION WORKSHEET CLIENT: FORT AP HILL BUILDING: 172- COMMUNITY CLUB

Type of Lamp	# of Lamps	x	Watts/ Lamp	x	Ballast Usage	/ 1000 =	KW	x	Hours/ Week	x	Weeks/ Month	x	Months/ Year	=	KWH/Year	x	$/KWH	=	$/Year	
STD.EXIT	22	x	25	x	1.0	/ 1000 =	0.55	x	168	x	4.345	x	12	=	4817.7	x	0.063	=	$ 303.52	Standard
LED.EXIT	11	x	6	x	1.2	/ 1000 =	0.079	x	168	x	4.345	x	12	=	693.8	x	0.063	=	$ 43.71	Replacement

REPLACEMENT of 25W EXIT SIGNS WITH 6W L.E.D. EXIT SIGNS

Energy Savings = 4123.9 KWH = $ 259.81

Demand Savings = ____ KW x ____ mo/yr = ____ KW x $____ /KW = $____

Cost = $____ x ____ = $____ Payback = ____ years

---

		x		x		/ 1000 =		x		x	4.345	x		=		x		=	$	Standard
		x		x		/ 1000 =		x		x	4.345	x		=		x		=	$	Replacement

Energy Savings = ____ KWH = $____

Demand Savings = ____ KW x ____ mo/yr = ____ KW x $____ /KW = $____

Cost = $____ x ____ = $____ Payback = ____ years

---

		x		x		/ 1000 =		x		x	4.345	x		=		x		=	$	Standard
		x		x		/ 1000 =		x		x	4.345	x		=		x		=	$	Replacement

Energy Savings = ____ KWH = $____

Demand Savings = ____ KW x ____ mo/yr = ____ KW x $____ /KW = $____

Cost = $____ x ____ = $____ Payback = ____ years

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		x		x		/ 1000 =		x		x	4.345	x		=		x		=	$	Standard
		x		x		/ 1000 =		x		x	4.345	x		=		x		=	$	Replacement

Energy Savings = ____ KWH = $____

Demand Savings = ____ KW x ____ mo/yr = ____ KW x $____ /KW = $____

Cost = $____ x ____ = $____ Payback = ____ years

Daylight Dimming Controls

LIFE CYCLE COST ANALYSIS SUMMARY
WITH SYNERGISTIC EFFECTS

LOCATION: Fort A.P. Hill, Virginia REGION: 3 PROJECT NO.: DACA 31-89-C-0198
PROJECT TITLE: Fort A.P. Hill- Energy Engineering Analysis Program FISCAL YEAR: 1994
DISCRETE PORTION NAME: Daylight Dimming Controls
ANALYSIS DATE: January 1994 ECONOMIC LIFE (YRS 15 PREPARER: JJS

1. INVESTMENT COSTS:

A. CONSTRUCTION COST	$	1,200
B. SIOH	$	66
C. DESIGN COST	$	72
D. TOTAL COST (1A+1B+1C)	$	1,338
E. SALVAGE VALUE OF EXISTING EQUIPMENT		
F. PUBLIC UTILITY COMPANY REBATE		
G. TOTAL INVESTMENT (1D-1E-1F)		$1,338

2. ENERGY SAVINGS (+)/COST(-):

DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS- Oct 1992

ENERGY SOURCE	COST $/MBTU(1)	SAVING(S) MBTU/YR(2)		ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)		DISCOUNTED SAVINGS(5)
A. ELEC	$20.67	0.6	$	12	11.77	$	136
B. DIST	$5.69		$		13.83	$	
C. RESID			$			$	
D. NG			$			$	
E. LPG	$7.76		$		15.34	$	
F. COAL			$			$	
G. SOLAR			$			$	
H. GEOTH			$			$	
I. BIOMA			$			$	
J. REFUS			$			$	
K. WIND			$			$	
L. OTHER			$			$	
M. DEMAND SAVINGS			$			$	
N. TOTAL		1	$	12		$	136

3. NON ENERGY SAVINGS (+) OR COST (-):

A. ANNUAL RECURRING (+/-)
(1) DISCOUNT FACTOR (TABLE A)
(2) DISCOUNTED SAVINGS/COST (3A X 3A1)

B. NON RECURRING SAVINGS (+) OR COST (-)

ITEM		SAVINGS(+) COST(-)(1)	YEAR OF OCCUR. (2)	DISCOUNT FACTOR(3)		DISCOUNTED SAV-INGS(+)COST(-)(4)
a.	$				$	
b.	$				$	
c.	$				$	
d. TOTAL					$	

C. TOTAL NON ENERGY DISCOUNTED SAVINGS (3A2+3Bd4)

4. SIMPLE PAYBACK 1G/(2N3+3A+(3Bd1/ECONOMIC LIFE)): 115.59 YEARS
5. TOTAL NET DISCOUNTED SAVINGS (2N5+3C): $136
6. SAVINGS TO INVESTMENT RATION (SIR) 5/1G: 0.10
7. ADJUSTED INTERNAL RATE OF RETURN (AIRR): -14.69%

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CONSTRUCTION COST ESTIMATE

PREPARED: March 1994 SHEET 1 OF 2

PROJECT: Energy Savings Oppurtunity Survey

CONTRACT NO.: DACA 31-89-C-0198

LOCATION: Fort A.P. Hill, Virginia
AE PROJECT NO.: 92008
AE: Engineering Applications Consultants, P.C.

ESTIMATOR: JS PRELIM:
CHECKED BY: VP FINAL: X

SUMMARY: Daylighting Dimming Controls (added to Occupancy Sensors)

ITEM	QUANTITY		MATERIAL		LABOR		TOTAL COST
	NO.	MEAS	UNIT	COST	UNIT	COST	
Building 172							
Daylight Dimming Controls	1	EA	180.00	180	100.00	100	280
SUB-TOTAL				180		100	280

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300

CONSTRUCTION COST ESTIMATE	PREPARED: March 1994 SHEET OF
PROJECT: Energy Savings Oppurtunity Survey	SHEET 2 OF 2 CONTRACT NO.: DACA 31-89-C-0198
LOCATION: Fort A.P. Hill, Virginia AE PROJECT NO.: AE: Engineering Applications Consultants, P.C.	ESTIMATOR: JS PRELIM: CHECKED BY: VP FINAL: X

SUMMARY: Daylighting Dimming Controls (added to Occupancy Sensors)

ITEM	QUANTITY		MATERIAL		LABOR		TOTAL COST
	NO.	MEAS	UNIT	COST	UNIT	COST	
SUBTOTAL PREVIOUS PAGE				180		100	280
MARK-UP ON LABOR SUB-TOTAL	21.0%			---		21	21 301
TAXES ON MATERIAL SUB-TOTAL	5.0%			9		----	9 310
OVERHEAD SUB-TOTAL	15.0%						47 357
PROFIT SUB-TOTAL	12.0%						43 399
PRIME MARK-UP ON SUB SUB-TOTAL							399
GRAND TOTAL							400

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ENERGY BUDGET <A>

Building : #172 Occ/Dim w/CF&34wLmp — 03-01-94
Site : Fort AP Hill, Virginia — 6063092204
Prepared By : E.A.C., P.C. Burke, VA
Carrier Hourly Analysis Program

TABLE 1. ANNUAL LOADS

Component	(kBTU)	(kBTU/sqft)*
Cooling Loads *	128,192	25.654
Heating Loads *	148,264	29.671

TABLE 2. ENERGY BY SYSTEM COMPONENT

Component	Site Energy (kBTU)	Site Energy (kBTU/sqft)*	Source Energy (kBTU)	Source Energy (kBTU/sqft)*
Air System Fans	93,902	18.792	93,902	18.792
Cooling Plants	53,334	10.673	53,334	10.673
Heating Plants	118,768	23.768	118,768	23.768
Pumps	0	0.000	0	0.000
>> HVAC Total	266,003	53.233	266,003	53.233
Lights	42,785	8.562	42,785	8.562
Other Electric	49,567	9.919	49,567	9.919
Misc. Electric	0	0.000	0	0.000
Dom. Hot Water	55,879	11.182	55,879	11.182
>> Non-HVAC Total	148,231	29.664	148,231	29.664
>> GRAND TOTAL	414,234	82.896	414,234	82.896

* Notes:
1. Site energy is the actual energy consumed.
2. Source energy accounts for electrical generating inefficiencies. For this study:
   Electric generating efficiency =100.0 %
3. Energy per unit floor area is based on the gross building floor area. For this building:
   Gross floor area = 4,997 sqft
   Conditioned floor area = 4,997 sqft
4. Annual cooling load is the sum of all cooling plant loads.
5. Annual heating load is the sum of all primary and auxiliary heating plant loads. It does not include the domestic water heating load.

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ENERGY BUDGET <B>

Building : #172 Occ/Dim w/CF&34wLmp — 03-01-94
Site : Fort AP Hill, Virginia — 6063092204
Prepared By : E.A.C., P.C. Burke, VA
Carrier Hourly Analysis Program

TABLE 1. ANNUAL LOADS

Component	(kBTU)	(kBTU/sqft)*
Cooling Loads *	128,192	25.654
Heating Loads *	148,264	29.671

TABLE 2. ENERGY BY ENERGY COMPONENT

Component	<----- Site Energy -----> (kBTU)	(kBTU/sqft)*	<---- Source Energy ----> (kBTU)	(kBTU/sqft)*
Electric	266,003	53.233	266,003	53.233
Natural Gas	0	0.000	0	0.000
Fuel Oil	0	0.000	0	0.000
Propane	0	0.000	0	0.000
Remote Heating	0	0.000	0	0.000
Remote Cooling	0	0.000	0	0.000
>> HVAC Total	266,003	53.233	266,003	53.233
Electric	148,231	29.664	148,231	29.664
Natural Gas	0	0.000	0	0.000
Fuel Oil	0	0.000	0	0.000
Propane	0	0.000	0	0.000
Remote Heating	0	0.000	0	0.000
>> Non-HVAC Total	148,231	29.664	148,231	29.664
>> GRAND TOTAL	414,234	82.896	414,234	82.896

* Notes:
1. Site energy is the actual energy consumed.
2. Source energy accounts for electrical generating inefficiencies. For this study:
   Electric generating efficiency =100.0 %
3. Energy per unit floor area is based on the gross building floor area. For this building:
   Gross floor area = 4,997 sqft
   Conditioned floor area = 4,997 sqft
4. Annual cooling load is the sum of all cooling plant loads.
5. Annual heating load is the sum of all primary and auxiliary heating plant loads. It does not include the domestic water heating load.

Economizer Controls

LIFE CYCLE COST ANALYSIS SUMMARY

LOCATION: Fort A.P. Hill, Virginia REGION: 3 PROJECT NO.: DACA 31-89-C-0198
PROJECT TITLE: Fort A.P. Hill- Energy Engineering Analysis Program FISCAL YEAR: 1994
DISCRETE PORTION NAME: Economizer Controls
ANALYSIS DATE: January 1994 ECONOMIC LIFE (YRS 10 PREPARER: JJS

1. INVESTMENT COSTS:

A. CONSTRUCTION COST	$	10,700	
B. SIOH	$	589	
C. DESIGN COST	$	642	
D. TOTAL COST (1A+1B+1C)	$	11,931	
E. SALVAGE VALUE OF EXISTING EQUIPMENT			
F. PUBLIC UTILITY COMPANY REBATE			
G. TOTAL INVESTMENT (1D-1E-1F)			$11,931

2. ENERGY SAVINGS (+)/COST(-):

DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS- Oct 1992

ENERGY SOURCE	COST $/MBTU(1)	SAVING(S) MBTU/YR(2)		ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)		DISCOUNTED SAVINGS(5)
A. ELEC	$20.67	7.1	$	146	8.39	$	1,224
B. DIST	$5.69		$		9.48	$	
C. RESID			$			$	
D. NG			$			$	
E. LPG	$7.76		$		15.34	$	
F. COAL			$			$	
G. SOLAR			$			$	
H. GEOTH			$			$	
I. BIOMA			$			$	
J. REFUS			$			$	
K. WIND			$			$	
L. OTHER			$			$	
M. DEMAND SAVINGS			$			$	
N. TOTAL		7	$	146		$	1,224

3. NON ENERGY SAVINGS (+) OR COST (-):

A. ANNUAL RECURRING (+/-)
(1) DISCOUNT FACTOR (TABLE A)
(2) DISCOUNTED SAVINGS/COST (3A X 3A1)

B. NON RECURRING SAVINGS (+) OR COST (-)

ITEM		SAVINGS(+) COST(-)(1)	YEAR OF OCCUR. (2)	DISCOUNT FACTOR(3)		DISCOUNTED SAV-INGS(+)COST(-)(4)
a.	$				$	
b.	$				$	
c.	$				$	
d. TOTAL					$	

C. TOTAL NON ENERGY DISCOUNTED SAVINGS (3A2+3Bd4)

4. SIMPLE PAYBACK 1G/(2N3+3A+(3Bd1/ECONOMIC LIFE)):	81.75 YEARS
5. TOTAL NET DISCOUNTED SAVINGS (2N5+3C):	$1,224
6. SAVINGS TO INVESTMENT RATION (SIR) 5/1G:	0.10
7. ADJUSTED INTERNAL RATE OF RETURN (AIRR):	-21.18%

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304

CONSTRUCTION COST ESTIMATE	PREPARED: March 1994 SHEET 1 OF 2
PROJECT: Energy Savings Oppurtunity Survey LOCATION: Fort A.P. Hill, Virginia AE PROJECT NO.: 92008 AE: Engineering Applications Consultants, P.C.	CONTRACT NO.: DACA 31-89-C-0198 ESTIMATOR: JS PRELIM: CHECKED BY: VP FINAL: X

SUMMARY: Economizer Controls

ITEM	QUANTITY		MATERIAL		LABOR		TOTAL COST
	NO.	MEAS	UNIT	COST	UNIT	COST	
Building 172							
Ductwork	1200	LBS	0.48	576	2.18	2,616	3,192
O.A. Louver	16	SF	35.00	560	7.35	118	678
Dampers	3	EA	147.00	441	34.00	102	543
Economizer Control Package	3	EA	75.00	225	50.00	150	375
Enthalpy Sensor	3	EA	95.00	285	30.00	90	375
4,400 cfm Exhaust Fan	1	EA	275.00	275	150.00	150	425
Control Wiring	200	LF	0.17	33	0.42	84	117
Damper Motor Actuator	3	EA	250.00	750	26.00	78	828
24x24 Return Registers	2	EA	65.00	130	18.75	38	168
Motor Starter in Nema One Enclosure	1	EA	150.00	150	130.00	130	280
3/4" Conduit (EMT)	150	LF	0.50	75	1.61	242	317
#12 THHN Wiring	150	LF	0.059	9	0.19	29	38
SUB-TOTAL				3,509		3,827	7,336

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CONSTRUCTION COST ESTIMATE

PROJECT: Energy Savings Oppurtunity Survey

LOCATION: Fort A.P. Hill, Virginia
AE PROJECT NO.:
AE: Engineering Applications Consultants, P.C.

PREPARED: March 1994 SHEET OF
SHEET 2 OF 2
CONTRACT NO.: DACA 31-89-C-0198

ESTIMATOR: JS PRELIM:
CHECKED BY: VP FINAL: X

SUMMARY:

ITEM	QUANTITY NO.	QUANTITY MEAS	MATERIAL UNIT	MATERIAL COST	LABOR UNIT	LABOR COST	TOTAL COST
SUBTOTAL PREVIOUS PAGE				3,509		3,827	7,336
MARK-UP ON LABOR SUB-TOTAL	21.0%			—		804	804 8,140
TAXES ON MATERIAL SUB-TOTAL	5.0%			175		—	175 8,315
OVERHEAD SUB-TOTAL	15.0%						1,247 9,562
PROFIT SUB-TOTAL	12.0%						1,147 10,710
PRIME MARK-UP ON SUB SUB-TOTAL							10,710
GRAND TOTAL							10,700

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3016

ENERGY BUDGET <A>

Building : #172- Economizer Control — 02-24-94

Site : Fort AP Hill, Virginia — 6063092204

Prepared By : E.A.C., P.C. Burke, VA

Carrier Hourly Analysis Program

TABLE 1. ANNUAL LOADS

Component	(kBTU)	(kBTU/sqft)*
Cooling Loads *	123,896	24.794
Heating Loads *	142,376	28.492

TABLE 2. ENERGY BY SYSTEM COMPONENT

	<----- Site Energy ----->		<---- Source Energy ---->	
Component	(kBTU)	(kBTU/sqft)*	(kBTU)	(kBTU/sqft)*
Air System Fans	94,201	18.852	94,201	18.852
Cooling Plants	51,041	10.214	51,041	10.214
Heating Plants	116,252	23.264	116,252	23.264
Pumps	0	0.000	0	0.000
>> HVAC Total	261,494	52.330	261,494	52.330
Lights	64,051	12.818	64,051	12.818
Other Electric	49,567	9.919	49,567	9.919
Misc. Electric	0	0.000	0	0.000
Dom. Hot Water	55,879	11.182	55,879	11.182
>> Non-HVAC Total	169,497	33.920	169,497	33.920
>> GRAND TOTAL	430,991	86.250	430,991	86.250

* Notes:
1. Site energy is the actual energy consumed.
2. Source energy accounts for electrical generating inefficiencies. For this study:
   Electric generating efficiency =100.0 %
3. Energy per unit floor area is based on the gross building floor area. For this building:
   Gross floor area = 4,997 sqft
   Conditioned floor area = 4,997 sqft
4. Annual cooling load is the sum of all cooling plant loads.
5. Annual heating load is the sum of all primary and auxiliary heating plant loads. It does not include the domestic water heating load.

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ENERGY BUDGET <B>

Building : #172- Economizer Control 02-24-94
Site : Fort AP Hill, Virginia 6063092204
Prepared By : E.A.C., P.C. Burke, VA
Carrier Hourly Analysis Program

TABLE 1. ANNUAL LOADS

Component	(kBTU)	(kBTU/sqft)*
Cooling Loads *	123,896	24.794
Heating Loads *	142,376	28.492

TABLE 2. ENERGY BY ENERGY COMPONENT

Component	<----- Site Energy -----> (kBTU)	(kBTU/sqft)*	<---- Source Energy ----> (kBTU)	(kBTU/sqft)*
Electric	261,494	52.330	261,494	52.330
Natural Gas	0	0.000	0	0.000
Fuel Oil	0	0.000	0	0.000
Propane	0	0.000	0	0.000
Remote Heating	0	0.000	0	0.000
Remote Cooling	0	0.000	0	0.000
>> HVAC Total	261,494	52.330	261,494	52.330
Electric	169,497	33.920	169,497	33.920
Natural Gas	0	0.000	0	0.000
Fuel Oil	0	0.000	0	0.000
Propane	0	0.000	0	0.000
Remote Heating	0	0.000	0	0.000
>> Non-HVAC Total	169,497	33.920	169,497	33.920
>> GRAND TOTAL	430,991	86.250	430,991	86.250

* Notes:
1. Site energy is the actual energy consumed.
2. Source energy accounts for electrical generating inefficiencies. For this study:
   Electric generating efficiency =100.0 %
3. Energy per unit floor area is based on the gross building floor area. For this building:
   Gross floor area = 4,997 sqft
   Conditioned floor area = 4,997 sqft
4. Annual cooling load is the sum of all cooling plant loads.
5. Annual heating load is the sum of all primary and auxiliary heating plant loads. It does not include the domestic water heating load.

Replace Exiting Fluorescent Fixtures with Energy Effiecient Fixtures, Ballast and Lamps

LIFE CYCLE COST ANALYSIS SUMMARY
WITH SYNERGISTIC EFFECTS

LOCATION: Fort A.P. Hill, Virginia   REGION: 3   PROJECT NO.: DACA 31-89-C-0198
PROJECT TITLE: Fort A.P. Hill- Energy Engineering Analysis Program   FISCAL YEAR: 1994
DISCRETE PORTION NAME: Replace Existing Fluorescent Fixtures with Energy Efficient Fixtures, Ballast and Lamps
ANALYSIS DATE: January 1994   ECONOMIC LIFE (YRS 20   PREPARER: JJS

1. INVESTMENT COSTS:

A. CONSTRUCTION COST	$	1,600	
B. SIOH	$	88	
C. DESIGN COST	$	96	
D. TOTAL COST (1A+1B+1C)	$	1,784	
E. SALVAGE VALUE OF EXISTING EQUIPMENT			
F. PUBLIC UTILITY COMPANY REBATE			
G. TOTAL INVESTMENT (1D-1E-1F)			$1,784

2. ENERGY SAVINGS (+)/COST(-):

DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS- Oct 1992

ENERGY SOURCE	COST $/MBTU(1)	SAVING(S) MBTU/YR(2)	ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELEC	$20.67	4.9	$ 101	14.65	$ 1,484
B. DIST	$5.69		$	17.70	$
C. RESID			$		$
D. NG			$		$
E. LPG	$7.76		$	20.60	$
F. COAL			$		$
G. SOLAR			$		$
H. GEOTH			$		$
I. BIOMA			$		$
J. REFUS			$		$
K. WIND			$		$
L. OTHER			$		$
M. DEMAND SAVINGS			$		$
N. TOTAL		5	$ 101		$ 1,484

3. NON ENERGY SAVINGS (+) OR COST (-):

A. ANNUAL RECURRING (+/-)
(1) DISCOUNT FACTOR (TABLE A)
(2) DISCOUNTED SAVINGS/COST (3A X 3A1)

B. NON RECURRING SAVINGS (+) OR COST (-)

ITEM	SAVINGS(+) COST(-)(1)	YEAR OF OCCUR. (2)	DISCOUNT FACTOR(3)	DISCOUNTED SAV-INGS(+)COST(-)(4)
a.	$			$
b.	$			$
c.	$			$
d. TOTAL				$

C. TOTAL NON ENERGY DISCOUNTED SAVINGS (3A2+3Bd4)

4. SIMPLE PAYBACK 1G/(2N3+3A+(3Bd1/ECONOMIC LIFE)):	17.61 YEARS
5. TOTAL NET DISCOUNTED SAVINGS (2N5+3C):	$1,484
6. SAVINGS TO INVESTMENT RATION (SIR) 5/1G:	0.83
7. ADJUSTED INTERNAL RATE OF RETURN (AIRR):	-0.95%

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CONSTRUCTION COST ESTIMATE

PREPARED: March 1994

PROJECT: Energy Savings Oppurtunity Survey

CONTRACT NO.: DACA 31-89-C-0198

LOCATION: Fort A.P. Hill, Virginia
AE PROJECT NO.: 92008
AE: Engineering Applications Consultants, P.C.

ESTIMATOR: JS PRELIM:
CHECKED BY: VP FINAL: X

SUMMARY: Replace Existing Fluorescent Fixtures with Energy Efficient Fixtures, Ballast and Lamps

ITEM	QUANTITY		MATERIAL		LABOR		TOTAL COST
	NO.	MEAS	UNIT	COST	UNIT	COST	
Building 172							
F32T-8 Lighting Retrofit							
Two Lamp Fixtures Ballast-	19	EA	27.00	513	16.00	304	817
F32T-8 Lamps	38	EA	6.00	228	1.50	57	285
SUB-TOTAL				741		361	1,102

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CONSTRUCTION COST ESTIMATE

PREPARED: March 1994 SHEET OF
SHEET 2 OF 2

PROJECT: Energy Savings Oppurtunity Survey

CONTRACT NO.: DACA 31-89-C-0198

LOCATION: Fort A.P. Hill, Virginia
AE PROJECT NO.:
AE: Engineering Applications Consultants, P.C.

ESTIMATOR: JS PRELIM:
CHECKED BY: VP FINAL: X

SUMMARY: Replace Existing Fluorescent Fixtures with Energy Efficient Fixtures, Ballast and Lamps

ITEM	QUANTITY		MATERIAL		LABOR		TOTAL COST
	NO.	MEAS	UNIT	COST	UNIT	COST	
SUBTOTAL PREVIOUS PAGE				741		361	1,102
MARK-UP ON LABOR SUB-TOTAL	21.0%			----		76	76 1,178
TAXES ON MATERIAL SUB-TOTAL	5.0%			37		---	37 1,215
OVERHEAD SUB-TOTAL	15.0%						182 1,397
PROFIT SUB-TOTAL	12.0%						168 1,565
PRIME MARK-UP ON SUB SUB-TOTAL							1,565
GRAND TOTAL							1,600

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ENERGY BUDGET <A>

Building : #172-T-8 Lighting System — 02-26-94
Site : Fort AP Hill, Virginia — 6063092204
Prepared By : E.A.C., P.C. Burke, VA
Carrier Hourly Analysis Program

TABLE 1. ANNUAL LOADS

Component	(kBTU)	(kBTU/sqft)*
Cooling Loads *	137,884	27.593
Heating Loads *	142,648	28.547

TABLE 2. ENERGY BY SYSTEM COMPONENT

Component	Site Energy (kBTU)	Site Energy (kBTU/sqft)*	Source Energy (kBTU)	Source Energy (kBTU/sqft)*
Air System Fans	94,272	18.866	94,272	18.866
Cooling Plants	57,279	11.463	57,279	11.463
Heating Plants	116,370	23.288	116,370	23.288
Pumps	0	0.000	0	0.000
>> HVAC Total	267,921	53.616	267,921	53.616
Lights	59,828	11.973	59,828	11.973
Other Electric	49,567	9.919	49,567	9.919
Misc. Electric	0	0.000	0	0.000
Dom. Hot Water	55,879	11.182	55,879	11.182
>> Non-HVAC Total	165,274	33.075	165,274	33.075
>> GRAND TOTAL	433,195	86.691	433,195	86.691

* Notes:
1. Site energy is the actual energy consumed.
2. Source energy accounts for electrical generating inefficiencies. For this study:
   Electric generating efficiency =100.0 %
3. Energy per unit floor area is based on the gross building floor area. For this building:
   Gross floor area = 4,997 sqft
   Conditioned floor area = 4,997 sqft
4. Annual cooling load is the sum of all cooling plant loads.
5. Annual heating load is the sum of all primary and auxiliary heating plant loads. It does not include the domestic water heating load.

ENERGY BUDGET <B>

Building : #172-T-8 Lighting System 02-26-94
Site : Fort AP Hill, Virginia 6063092204
Prepared By : E.A.C., P.C. Burke, VA
Carrier Hourly Analysis Program

TABLE 1. ANNUAL LOADS

Component	(kBTU)	(kBTU/sqft)*
Cooling Loads *	137,884	27.593
Heating Loads *	142,648	28.547

TABLE 2. ENERGY BY ENERGY COMPONENT

	<----- Site Energy ----->		<---- Source Energy ---->	
Component	(kBTU)	(kBTU/sqft)*	(kBTU)	(kBTU/sqft)*
Electric	267,921	53.616	267,921	53.616
Natural Gas	0	0.000	0	0.000
Fuel Oil	0	0.000	0	0.000
Propane	0	0.000	0	0.000
Remote Heating	0	0.000	0	0.000
Remote Cooling	0	0.000	0	0.000
>> HVAC Total	267,921	53.616	267,921	53.616
Electric	165,274	33.075	165,274	33.075
Natural Gas	0	0.000	0	0.000
Fuel Oil	0	0.000	0	0.000
Propane	0	0.000	0	0.000
Remote Heating	0	0.000	0	0.000
>> Non-HVAC Total	165,274	33.075	165,274	33.075
>> GRAND TOTAL	433,195	86.691	433,195	86.691

* Notes:
1. Site energy is the actual energy consumed.
2. Source energy accounts for electrical generating inefficiencies. For this study:
   Electric generating efficiency =100.0 %
3. Energy per unit floor area is based on the gross building floor area. For this building:
   Gross floor area = 4,997 sqft
   Conditioned floor area = 4,997 sqft
4. Annual cooling load is the sum of all cooling plant loads.
5. Annual heating load is the sum of all primary and auxiliary heating plant loads. It does not include the domestic water heating load.

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Building 174- Computer Simulation Input Data

BUILDING DESCRIPTION

Building : #174 AP HILL-GUEST HOUSE — 03-14-94

Prepared By: E.A.C., P.C. Burke, VA — 6063092204

Carrier Hourly Analysis Program —

****

1. BUILDING INPUTS

BUILDING NAME = #174 AP HILL-GUEST HOUSE

MISCELLANEOUS ELECTRIC

Maximum power	=	0.0 kW
Power schedule	=	1

DOMESTIC WATER HEATING

Is a domestic how water system used	?	Y
Maximum hourly hot water use	=	50.0 gal
Hot water schedule	=	2
Average entering water temperature	=	50.0 F
Average hot water supply temperature	=	120.0 F
Heating plant type	=	1 : Electric

OTHER INPUTS

Additional building floor area	=	251.0 sqft
Electrical generating efficiency	=	100.00 %

****

2. PLANT SELECTION

Plant Name	Mult	Plant Name	Mult
BASEMENT	1	#201	1
#202	1	#203	1
#204	1	#205	1
#206	1		

****

3. FUEL & ELECTRIC RATE SELECTION

Fuel or Energy	No.	Name of Rate Schedule	Currency
Electric	1	RAPPAHANNOCK	$
Natural Gas	1	LPG	$
Fuel Oil	1	LPG	$
Propane	1	LPG	$
Remote Source Heating	1	LPG	$
Remote Source Cooling	1	LPG	$

****

8/4

Engineering
Applications
Consultants

EAC STANDARD FORM
August 1985

Contract No. DACA-31-89-C-0198

HEAT GAIN AND LOSS CALCULATIONS

Preliminary Selection
Final Selection

Project Name: FORT A.P HILL ESOS

EAC Project Number: 92008 Date MARCH 94 By: JS

Location: FORT A P HILL

North Altitude 38.1 Design Month ______

Building Construction:

- ☐ Light
- ☒ Medium
- ☐ Heavy

Thermal Load Averaging Hours ______

Design Conditions

	Summer		Winter
Outside:	DB 93 F	WB 76 F	DB 14 F
Inside:	DB 78 F	WB 60 F	DB 70 F

U-Factors

Roof .030
Floor .57
Wall .47, .068
Partition ______ Door .30
Glass (Shading) ______
Glass (No Shading) .68
Shading Coefficient
For Glass ______ (Shading) ______ (No Shading)

Lighting Level ______

Occupancy ______

General Remarks ______

315

Engineering
Applications
Consultants

EAC STANDARD FORM
July 1985

SHEET NO. ______

U-VALUE CALCULATION FORM

FOR WALL/PARTITION

Project: ESOS FORT AP HILL VA

EAC Project Number: 92008 Date: 12-9-92 By: JS

☒ Wall (12" cmu) ☐ Partition

Material	Resistance ($h\text{-}ft^2$ - F/Btu) Summer	Winter
1. Outside Air	0.25	0.17
2. Inside Still Air	0.68	0.68
3. 8' cmu	1.2	
4.		
5.		
6.		
7.		
8.		
Total (R) =	2.13	
U = 1/R =		

(Btu/h-sq.ft. - F)

MATERIAL	R*	MATERIAL	R*
Air Space 3/4" (90 F)	0.84	Blanket/Batt Insul.	
Air Space 3/4" (0 F)	1.18	2-2 3/4 in.	7.00
Still Air	0.68	3-4 in.	11.00
Moving Air 7 1/2 MPH	0.25	3.5 in	13.00
Moving Air 15 MPH	0.17	5.5-6.5 in.	19.00
Face Brick 4"	0.44	6-7.5 in.	22.00
Cinderblock 4"	1.11	9-10 in.	30.00
Cinderblock 8"	1.72	12-13 in.	38.00
Cinderblock 12"	1.89	Rigid Insul. 1"	2.78
Gypsum Bd 3/8"	0.32	Stryofoam 1"	4.00
Gypsum Bd 1/2"	0.45	Vermiculite 1"	2.27
Gypsum Plaster 1/2"	0.45	Vapor Barr.-felt	0.06
Sand Plaster 3/8"	0.08	Fir, Pine & Simil.	
Loose Fill Sandust 1"	2.22	Woods 3/4"	0.94
Perlite Expanded 1"	2.90		

*(h-sq.ft. - F/Btu)

Engineering
Applications
Consultants

EAC STANDARD FORM
July 1985

SHEET NO. ______

U-VALUE CALCULATION FORM

FOR ROOF/FLOOR

Project: ESOS FORT AP HILL

EAC Project Number: 92008 Date: 12-9-92 By: JS

☒ Roof ☐ Floor

	Material	Resistance (h-sq. ft.-F/Btu) Summer	Winter
1.	Top Surface (Moving Air)	0.25	0.17
2.	Bottom Surface (Still Air)	.68	.68
3.	SHINGLES - FIBERGLASS/ASPHALT	.44	.44
4.	#15 ROOF FELT	—	—
5.	5/8" CDX PLYWOOD	1.2	1.2
6.	BATT INS. (10")	30	30
7.	5/8" DROP CEILING	1.25	1.25
8.			
	Total (R) =	33.82	33.74
	U = 1/R =	.030	.030

(Btu/h-sq.ft. - F)

MATERIAL	DIRECTION OF HEAT FLOW	R*
Air Space 3/4" (0 F)	UP	0.93
Air Space 4"	UP	1.03
Air Space 3/4" (90 F)	DN	0.85
Air Space 4"	DN	1.00
Still Air	UP	0.61
Still Air	DN	0.92
Moving Air 7 1/2 MPH	ANY	0.25
Moving Air 15 MPH	ANY	0.17
Acoustical Tile 1/2"		1.25
Acoustical Tile 3/4"		1.89
Sand Plaster 3/8"		0.08
Gypsum Plaster 1/2"		0.45

MATERIAL	R*
Batt/Blanket	
2-2 3/4 in.	7.00
3-4in.	11.00
3.5 in.	13.00
5.5-6.5 in.	19.00
6-7.5 in.	22.00
9-10 in.	30.00
12-13 in.	38.00
Rigid Insul. 1"	2.78
Stryofoam 1"	4.00
Built-up Roof 3/8"	0.33
Asphalt Shingles	0.44

*(h-sq.ft. - F/Btu)

Engineering
Applications
Consultants

EAC STANDARD FORM
July 1985

SHEET NO. ______

U-VALUE CALCULATION FORM

FOR ROOF/FLOOR

Project: ESOS FORT A.P. HILL

EAC Project Number: 92008 Date: 12-9-92 By: JS

☐ Roof ☒ Floor

Material	Resistance (h-sq. ft.-F/Btu) Summer	Winter
1. Top Surface (Moving Air)	0.25	0.17
2. Bottom Surface (Still Air)	.68	
3. 4" CONCRETE (.2×4)	.8	
4.		
5.		
6.		
7.		
8.		
Total (R) =	1.73	
U = 1/R =		

(Btu/h-sq.ft. - F)

MATERIAL	DIRECTION OF HEAT FLOW	R*
Air Space 3/4" (0 F)	UP	0.93
Air Space 4"	UP	1.03
Air Space 3/4" (90 F)	DN	0.85
Air Space 4"	DN	1.00
Still Air	UP	0.61
Still Air	DN	0.92
Moving Air 7 1/2 MPH	ANY	0.25
Moving Air 15 MPH	ANY	0.17
Acoustical Tile 1/2"		1.25
Acoustical Tile 3/4"		1.89
Sand Plaster 3/8"		0.08
Gypsum Plaster 1/2"		0.45

MATERIAL	R*
Batt/Blanket	
2-2 3/4 in.	7.00
3-4in.	11.00
3.5 in.	13.00
5.5-6.5 in.	19.00
6-7.5 in.	22.00
9-10 in.	30.00
12-13 in.	38.00
Rigid Insul. 1"	2.78
Stryofoam 1"	4.00
Built-up Roof 3/8"	0.33
Asphalt Shingles	0.44

*(h-sq.ft. - F/Btu)

Engineering
Applications
Consultants

EAC STANDARD FORM
July 1985

SHEET NO. ①

U-VALUE CALCULATION FORM

FOR WALL/PARTITION

Project: ESOS FORT AP HILL

EAC Project Number: 92008 Date: 12-9-92 By: JS

☐ Wall TYPE D ☐ Partition

	Material	Resistance (h-ft^2 - F/Btu) Summer	Winter
1.	Outside Air	0.25	0.17
2.	Inside Still Air	0.68	0.68
3.	5/8'' T-111 SIDING (PINE)	.94	
4.	1/2'' CDX SHEATHING	1.2	
5.	R-11 Batt INSULATION	11	
6.	1/2'' GYP BOARD	.45	
7.			
8.			
	Total (R) =	14.52	
	U = 1/R =		

(Btu/h-sq.ft. - F)

MATERIAL	R*	MATERIAL	R*
Air Space 3/4" (90 F)	0.84	Blanket/Batt Insul.	
Air Space 3/4" (0 F)	1.18	2-2 3/4 in.	7.00
Still Air	0.68	3-4 in.	11.00
Moving Air 7 1/2 MPH	0.25	3.5 in	13.00
Moving Air 15 MPH	0.17	5.5-6.5 in.	19.00
Face Brick 4"	0.44	6-7.5 in.	22.00
Cinderblock 4"	1.11	9-10 in.	30.00
Cinderblock 8"	1.72	12-13 in.	38.00
Cinderblock 12"	1.89	Rigid Insul. 1"	2.78
Gypsum Bd 3/8"	0.32	Stryofoam 1"	4.00
Gypsum Bd 1/2"	0.45	Vermiculite 1"	2.27
Gypsum Plaster 1/2"	0.45	Vapor Barr.-felt	0.06
Sand Plaster 3/8"	0.08	Fir, Pine & Simil.	
Loose Fill Sandust 1"	2.22	Woods 3/4"	0.94
Perlite Expanded 1"	2.90		

*(h-sq.ft. - F/Btu)

Prepared By : E.A.C., P.C. Burke, VA 03-14-94
Carrier Hourly Analysis Program 6063092204

****

MASTER SCHEDULE 1. OCCUPANCY - BASEMENT Hourly Percentages

Hour ----->	0	1	2	3	4	5	6	7	8	9	10	11
Weekday	25	25	0	0	0	0	0	0	0	0	0	0
Saturday	50	25	0	0	0	0	0	0	0	0	0	0
Sunday	25	25	0	0	0	0	0	0	0	0	0	0
DESIGN	25	25	0	0	0	0	0	25	25	50	50	50

Hour ----->	12	13	14	15	16	17	18	19	20	21	22	23
Weekday	0	0	0	0	50	50	100	100	100	100	50	50
Saturday	0	0	0	0	50	50	100	100	100	100	50	50
Sunday	0	0	0	0	50	50	100	100	100	100	50	50
DESIGN	50	50	50	50	50	50	100	100	100	100	100	100

****

MASTER SCHEDULE 2. HOT WATER USE Hourly Percentages

Hour ----->	0	1	2	3	4	5	6	7	8	9	10	11
Weekday	50	50	0	0	0	0	50	50	50	50	0	0
Saturday	50	50	0	0	0	0	0	50	50	50	50	0
Sunday	50	50	0	0	0	0	0	0	25	25	25	25
DESIGN	50	50	0	0	0	0	50	50	50	50	0	0

Hour ----->	12	13	14	15	16	17	18	19	20	21	22	23
Weekday	0	0	0	0	0	80	80	100	100	100	50	50
Saturday	0	0	0	0	0	80	80	100	100	100	100	50
Sunday	0	0	0	0	0	80	80	80	80	80	80	50
DESIGN	0	0	0	0	0	100	100	100	100	100	100	100

****

MASTER SCHEDULE 3. GUEST ROOMS OCCUPANCY Hourly Percentages

Hour ----->	0	1	2	3	4	5	6	7	8	9	10	11
Weekday	50	50	50	50	50	50	50	50	50	50	50	50
Saturday	25	25	25	25	25	25	25	25	25	25	25	25
Sunday	25	25	25	25	25	25	25	25	25	25	25	25
DESIGN	50	50	50	50	50	50	50	50	50	50	50	50

Hour ----->	12	13	14	15	16	17	18	19	20	21	22	23
Weekday	50	50	50	50	50	50	50	50	50	50	50	50
Saturday	25	25	25	25	25	25	25	25	25	25	25	25
Sunday	25	25	25	25	25	25	25	25	25	25	25	25
DESIGN	50	50	50	50	50	50	50	50	50	50	50	50

****

7 70

****

MASTER SCHEDULE 4. GUEST ROOMS MISC. Hourly Percentages

Hour ----->	0	1	2	3	4	5	6	7	8	9	10	11
Weekday	10	10	10	10	10	10	50	50	50	50	10	10
Saturday	10	10	10	10	10	25	25	25	25	25	10	10
Sunday	10	10	10	10	10	10	10	25	25	25	25	25
DESIGN	50	50	50	50	50	50	50	50	50	50	50	50

Hour ----->	12	13	14	15	16	17	18	19	20	21	22	23
Weekday	10	10	10	10	50	50	50	50	50	50	50	50
Saturday	10	10	10	10	10	25	25	25	50	50	50	50
Sunday	25	25	25	25	25	50	50	50	50	50	50	50
DESIGN	50	50	50	50	50	50	50	50	50	50	50	50

****

MASTER SCHEDULE 5. Bsmnt Restrm Occ. Sensor Hourly Percentages

Hour ----->	0	1	2	3	4	5	6	7	8	9	10	11
Weekday	15	15	0	0	0	0	0	0	0	0	0	0
Saturday	15	15	0	0	0	0	0	0	0	0	0	0
Sunday	15	15	0	0	0	0	0	0	0	0	0	0
DESIGN	10	10	0	0	0	0	0	15	15	15	20	20

Hour ----->	12	13	14	15	16	17	18	19	20	21	22	23
Weekday	0	0	0	0	15	15	20	20	20	20	20	20
Saturday	0	0	0	0	15	15	20	20	20	20	20	20
Sunday	0	0	0	0	15	15	20	20	20	20	20	20
DESIGN	20	20	20	20	20	20	20	20	20	20	20	20

****

MASTER SCHEDULE 6. Gstrm Light Occ.Sens. Hourly Percentages

Hour ----->	0	1	2	3	4	5	6	7	8	9	10	11
Weekday	0	0	0	0	0	25	50	50	50	25	0	0
Saturday	0	0	0	0	0	25	50	50	50	50	25	0
Sunday	25	25	25	25	25	25	25	25	25	0	0	0
DESIGN	0	0	0	0	0	25	50	50	25	25	0	0

Hour ----->	12	13	14	15	16	17	18	19	20	21	22	23
Weekday	0	0	0	0	25	50	50	50	50	50	50	25
Saturday	0	0	0	0	25	25	25	25	25	25	25	25
Sunday	0	0	0	0	25	25	25	25	25	25	25	25
DESIGN	0	0	0	0	25	25	50	50	50	50	50	25

****

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MASTER SCHEDULE 7. Occupancy Sens.-Laundry Hourly Percentages

Hour ----->	0	1	2	3	4	5	6	7	8	9	10	11
Weekday	0	0	0	0	0	0	25	25	10	0	0	0
Saturday	0	0	0	0	0	0	25	25	0	0	10	10
Sunday	0	0	0	0	0	0	25	25	10	0	0	0
DESIGN	0	0	0	0	0	0	25	25	10	0	0	0

Hour ----->	12	13	14	15	16	17	18	19	20	21	22	23
Weekday	0	0	0	0	0	0	25	25	25	0	0	0
Saturday	10	0	0	0	25	25	25	0	0	0	0	0
Sunday	0	0	0	0	25	25	50	25	0	0	0	0
DESIGN	0	0	0	0	0	0	25	50	25	10	0	0

MASTER SCHEDULE 8. Bathrm Occ. Sensors Hourly Percentages

Hour ----->	0	1	2	3	4	5	6	7	8	9	10	11
Weekday	0	0	0	0	0	25	25	50	50	25	0	0
Saturday	0	0	0	0	0	25	25	50	50	25	0	0
Sunday	0	0	0	0	0	25	25	50	50	25	0	0
DESIGN	0	0	0	0	0	25	25	50	50	25	0	0

Hour ----->	12	13	14	15	16	17	18	19	20	21	22	23
Weekday	0	0	0	25	25	25	0	25	25	25	0	0
Saturday	0	0	0	0	25	25	25	25	25	0	0	0
Sunday	0	0	0	0	25	25	25	25	25	0	0	0
DESIGN	0	0	0	25	25	25	0	25	25	25	0	0

PLANT DESCRIPTIONS

Plant : BASEMENT 03-14-94

Prepared By : E.A.C., P.C. Burke, VA 6063092204

Carrier Hourly Analysis Program

****

1 PLANT NAME AND TYPES

Class	= Heat Pumps
Name	= BASEMENT
Heat Pump Type	= Air Source Heat Pump
Auxiliary Plant Type	= Electrical Resistance

****

2 AIR SYSTEM SELECTION

Air System Name	Mult	Air System Name	Mult
BASEMENT	1		

****

3 PLANT CHARACTERISTICS (Air Source Heat Pump)

COOLING DATA

Estimated maximum cooling coil load	= 4.19 Ton
Capacity at 95.0 F outdoor air	= 4.00 Ton
Input power rate at 95.0 F outdoor air	= 1.550 kW/Ton

HEATING DATA

Estimated maximum heating coil load	= 61.75 MBH
Capacity at 47.0 F outdoor air	= 47.5 MBH
Compressor, evaporator fan kW at 47.0 F outdoor air	= 5.2 kW
Outdoor air temperature for cutoff	= 42.0 F

AUXILIARY PLANT DATA

Plant type	= Electrical
Estimated maximum heating coil load	= 61.75 MBH
Type of heating	= Direct

****

4 PUMP SYSTEM DATA

(No inputs required)

****

AIR SYSTEM DESCRIPTION

Name : BASEMENT 03-14-94
Carrier Hourly Analysis Program 6063092204
Prepared By : E.A.C., P.C. Burke, VA

1. SYSTEM NAME AND TYPE

System Name = BASEMENT
System Class = Constant Volume
System Type = (SZCV) Single Zone Constant Volume
Operation Type = 3 Cooling & Heating
Type of Heating = 1 Central Heating

2. SPACE SELECTION (see separate printout)

3. THERMOSTAT & EQUIPMENT SCHEDULING DATA

Operation Period	Thermostat Setpoints Cooling	Heating	Ventilation Dampers
Occupied	78.0 F	70.0 F	OPEN
Unoccupied	78.0 F	70.0 F	CLOSED

Weekday	: Occupied Period Begins at 10	; Duration	= 16 hrs
Saturday	: Occupied Period Begins at 10	; Duration	= 16 hrs
Sunday	: Occupied Period Begins at 10	; Duration	= 16 hrs
Design Day	: Occupied Period Begins at 0	; Duration	= 24 hrs

4. SUPPLY, VENTILATION, RETURN AIR DATA

SUPPLY AIR
Supply air temperature = 55.0 F
Heating supply temperature = 110.0 F
Fan operation for heating = 1 Continuous

VENTILATION AIR
Nominal ventilation flow rate = 15.00 CFM/person
Minimum ventilation flow rate = 0.00 CFM/person
Damper leak rate = 0 % of vent air

RETURN AIR
Zone exhaust air flow rate = 0.00 CFM
Zone exhaust fan power = 0.0 kW
Is a return plenum used ? N

****

5. FAN DATA

SUPPLY FAN

Type	=	2:Forward curved
Static	=	2.00 in wg
Efficiency	=	54 %
Configuration	=	1 Draw-thru

RETURN FAN

Type	=	1:(Fan does not exist)

****

6. ACCESSORY DEVICES AND SYSTEMS

PREHEAT COIL
(Not used)

OUTDOOR AIR ECONOMIZER CONTROL
(Not used)

VENTILATION AIR RECLAIM
(Not used)

HUMIDITY CONTROL
(Not used)

****

7. MISCELLANEOUS SYSTEM DATA

Cooling coil bypass factor	=	0.050
Type of supplemental heating	=	1 Not Used

****

AIR SYSTEM SPACE LIST

Name : BASEMENT 03-14-94
Carrier Hourly Analysis Program 6063092204
Prepared By : E.A.C., P.C. Burke, VA Page 1

Space Name	Qty.	Space Name	Qty.
TABLE 1. SPACES IN ZONE 1			
1 REC ROOM BSMT	x 1	4 LADIES BSMT	x 1
2 SUPPLY BSMT	x 1	5 LAUNDRY BSMT	x 1
3 MENS BSMT	x 1		

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PLANT DESCRIPTIONS

Plant : #201 03-14-94
Prepared By : E.A.C., P.C. Burke, VA 6063092204
Carrier Hourly Analysis Program

****

1 PLANT NAME AND TYPES

Class	= Heat Pumps
Name	= #201
Heat Pump Type	= Air Source Heat Pump
Auxiliary Plant Type	= Electrical Resistance

****

2 AIR SYSTEM SELECTION

Air System Name	Mult	Air System Name	Mult
#201	1		

****

3 PLANT CHARACTERISTICS (Air Source Heat Pump)

COOLING DATA

Estimated maximum cooling coil load	= 0.73 Ton
Capacity at 95.0 F outdoor air	= 0.96 Ton
Input power rate at 95.0 F outdoor air	= 1.375 kW/Ton

HEATING DATA

Estimated maximum heating coil load	= 7.80 MBH
Capacity at 47.0 F outdoor air	= 11.6 MBH
Compressor, evaporator fan kW at 47.0 F outdoor air	= 3.6 kW
Outdoor air temperature for cutoff	= 42.0 F

AUXILIARY PLANT DATA

Plant type	= Electrical
Estimated maximum heating coil load	= 7.80 MBH
Type of heating	= Direct

****

4 PUMP SYSTEM DATA

(No inputs required)

****

AIR SYSTEM DESCRIPTION

Name : #201 — 03-14-94

Carrier Hourly Analysis Program — 6063092204

Prepared By : E.A.C., P.C. Burke, VA —

****

1. SYSTEM NAME AND TYPE

System Name = #201
System Class = Constant Volume
System Type = (SZCV) Single Zone Constant Volume
Operation Type = 3 Cooling & Heating
Type of Heating = 1 Central Heating

****

2. SPACE SELECTION (see separate printout)

****

3. THERMOSTAT & EQUIPMENT SCHEDULING DATA

Operation Period	Thermostat Setpoints Cooling	Thermostat Setpoints Heating	Ventilation Dampers
Occupied	78.0 F	70.0 F	OPEN
Unoccupied	78.0 F	70.0 F	CLOSED

Weekday	: Occupied Period Begins at 0	; Duration	= 24 hrs
Saturday	: Occupied Period Begins at 0	; Duration	= 24 hrs
Sunday	: Occupied Period Begins at 0	; Duration	= 24 hrs
Design Day	: Occupied Period Begins at 0	; Duration	= 24 hrs

****

4. SUPPLY, VENTILATION, RETURN AIR DATA

SUPPLY AIR

Supply air temperature = 55.0 F
Heating supply temperature = 100.0 F
Fan operation for heating = 2 Cycled

VENTILATION AIR

Nominal ventilation flow rate = 10.00 % of supply air
Minimum ventilation flow rate = 10.00 % of supply air
Damper leak rate = 5 % of vent air

RETURN AIR

Zone exhaust air flow rate = 0.00 CFM
Zone exhaust fan power = 0.0 kW
Is a return plenum used ? N

****

AIR SYSTEM DESCRIPTION

Name : #201 03-14-94

Carrier Hourly Analysis Program 6063092204

Prepared By : E.A.C., P.C. Burke, VA

****

5. FAN DATA

SUPPLY FAN

Type	=	2:Forward curved
Static	=	0.50 in wg
Efficiency	=	54 %
Configuration	=	1 Draw-thru

RETURN FAN

Type	=	1:(Fan does not exist)

****

6. ACCESSORY DEVICES AND SYSTEMS

PREHEAT COIL

(Not used)

OUTDOOR AIR ECONOMIZER CONTROL

(Not used)

VENTILATION AIR RECLAIM

(Not used)

HUMIDITY CONTROL

(Not used)

****

7. MISCELLANEOUS SYSTEM DATA

Cooling coil bypass factor	=	0.050
Type of supplemental heating	=	1 Not Used

****

AIR SYSTEM SPACE LIST

Name : #201 03-14-94

Carrier Hourly Analysis Program 6063092204

Prepared By : E.A.C., P.C. Burke, VA

Space Name	Qty.	Space Name	Qty.
TABLE 1. SPACES IN ZONE 1			
6 201	x 1		

PLANT DESCRIPTIONS

Plant : #202 03-14-94
Prepared By : E.A.C., P.C. Burke, VA 6063092204
Carrier Hourly Analysis Program Page 1 of 1

****

1 PLANT NAME AND TYPES

Class	=	Heat Pumps
Name	=	#202
Heat Pump Type	=	Air Source Heat Pump
Auxiliary Plant Type	=	Electrical Resistance

****

2 AIR SYSTEM SELECTION

Air System Name	Mult	Air System Name	Mult
#202	1		

****

3 PLANT CHARACTERISTICS (Air Source Heat Pump)

COOLING DATA		
Estimated maximum cooling coil load	=	0.88 Ton
Capacity at 95.0 F outdoor air	=	0.96 Ton
Input power rate at 95.0 F outdoor air	=	1.375 kW/Ton
HEATING DATA		
Estimated maximum heating coil load	=	7.77 MBH
Capacity at 47.0 F outdoor air	=	11.6 MBH
Compressor, evaporator fan kW at 47.0 F outdoor air	=	3.6 kW
Outdoor air temperature for cutoff	=	42.0 F
AUXILIARY PLANT DATA		
Plant type	=	Electrical
Estimated maximum heating coil load	=	7.77 MBH
Type of heating	=	Direct

****

4 PUMP SYSTEM DATA

(No inputs required)

****

****

1. SYSTEM NAME AND TYPE
   System Name = #202
   System Class = Constant Volume
   System Type = (SZCV) Single Zone Constant Volume
   Operation Type = 3 Cooling & Heating
   Type of Heating = 1 Central Heating

****

2. SPACE SELECTION (see separate printout)

****

3. THERMOSTAT & EQUIPMENT SCHEDULING DATA

Operation Period	Thermostat Setpoints Cooling	Thermostat Setpoints Heating	Ventilation Dampers
Occupied	78.0 F	70.0 F	OPEN
Unoccupied	78.0 F	70.0 F	CLOSED

Weekday	: Occupied Period Begins at	0	; Duration	= 24 hrs
Saturday	: Occupied Period Begins at	0	; Duration	= 24 hrs
Sunday	: Occupied Period Begins at	0	; Duration	= 24 hrs
Design Day	: Occupied Period Begins at	0	; Duration	= 24 hrs

****

4. SUPPLY, VENTILATION, RETURN AIR DATA

SUPPLY AIR

Supply air temperature	=	55.0 F
Heating supply temperature	=	100.0 F
Fan operation for heating	=	2 Cycled

VENTILATION AIR

Nominal ventilation flow rate	=	10.00 % of supply air
Minimum ventilation flow rate	=	10.00 % of supply air
Damper leak rate	=	5 % of vent air

RETURN AIR

Zone exhaust air flow rate	=	0.00 CFM
Zone exhaust fan power	=	0.0 kW
Is a return plenum used	?	N

****

****

5. FAN DATA
SUPPLY FAN
Type = 2:Forward curved
Static = 0.50 in wg
Efficiency = 54 %
Configuration = 1 Draw-thru
RETURN FAN
Type = 1:(Fan does not exist)
****

6. ACCESSORY DEVICES AND SYSTEMS
PREHEAT COIL
(Not used)
OUTDOOR AIR ECONOMIZER CONTROL
(Not used)
VENTILATION AIR RECLAIM
(Not used)
HUMIDITY CONTROL
(Not used)
****

7. MISCELLANEOUS SYSTEM DATA
Cooling coil bypass factor = 0.050
Type of supplemental heating = 1 Not Used
****

AIR SYSTEM SPACE LIST

Name : #202 03-14-94

Carrier Hourly Analysis Program 6063092204

Prepared By : E.A.C., P.C. Burke, VA Page 1

Space Name	Qty.	Space Name	Qty.
TABLE 1. SPACES IN ZONE 1			
7 202	x 1		

334

****

1 PLANT NAME AND TYPES

Class	= Heat Pumps
Name	= #203
Heat Pump Type	= Air Source Heat Pump
Auxiliary Plant Type	= Electrical Resistance

****

2 AIR SYSTEM SELECTION

Air System Name	Mult	Air System Name	Mult
#203	1		

****

3 PLANT CHARACTERISTICS (Air Source Heat Pump)

COOLING DATA

Estimated maximum cooling coil load	=	0.60 Ton
Capacity at 95.0 F outdoor air	=	0.96 Ton
Input power rate at 95.0 F outdoor air	=	1.375 kW/Ton

HEATING DATA

Estimated maximum heating coil load	=	7.13 MBH
Capacity at 47.0 F outdoor air	=	11.6 MBH
Compressor, evaporator fan kW at 47.0 F outdoor air	=	3.6 kW
Outdoor air temperature for cutoff	=	42.0 F

AUXILIARY PLANT DATA

Plant type	=	Electrical
Estimated maximum heating coil load	=	7.13 MBH
Type of heating	=	Direct

****

4 PUMP SYSTEM DATA

(No inputs required)

****

AIR SYSTEM DESCRIPTION

Name : #203 03-14-94
Carrier Hourly Analysis Program 6063092204
Prepared By : E.A.C., P.C. Burke, VA

****

1. SYSTEM NAME AND TYPE

System Name = #203
System Class = Constant Volume
System Type = (SZCV) Single Zone Constant Volume
Operation Type = 3 Cooling & Heating
Type of Heating = 1 Central Heating

****

2. SPACE SELECTION (see separate printout)

****

3. THERMOSTAT & EQUIPMENT SCHEDULING DATA

Operation Period	Thermostat Setpoints Cooling	Heating	Ventilation Dampers
Occupied	78.0 F	70.0 F	OPEN
Unoccupied	78.0 F	70.0 F	CLOSED

Weekday : Occupied Period Begins at 0 ; Duration = 24 hrs
Saturday : Occupied Period Begins at 0 ; Duration = 24 hrs
Sunday : Occupied Period Begins at 0 ; Duration = 24 hrs
Design Day : Occupied Period Begins at 0 ; Duration = 24 hrs

****

4. SUPPLY, VENTILATION, RETURN AIR DATA

SUPPLY AIR
Supply air temperature = 55.0 F
Heating supply temperature = 100.0 F
Fan operation for heating = 2 Cycled

VENTILATION AIR
Nominal ventilation flow rate = 10.00 % of supply air
Minimum ventilation flow rate = 10.00 % of supply air
Damper leak rate = 5 % of vent air

RETURN AIR
Zone exhaust air flow rate = 0.00 CFM
Zone exhaust fan power = 0.0 kW
Is a return plenum used ? N

****

AIR SYSTEM DESCRIPTION

Name : #203 03-14-94

Carrier Hourly Analysis Program 6063092204

Prepared By : E.A.C., P.C. Burke, VA

****

5. FAN DATA

SUPPLY FAN

Type	=	2:Forward curved
Static	=	0.50 in wg
Efficiency	=	54 %
Configuration	=	1 Draw-thru

RETURN FAN

Type	=	1:(Fan does not exist)

****

6. ACCESSORY DEVICES AND SYSTEMS

PREHEAT COIL

(Not used)

OUTDOOR AIR ECONOMIZER CONTROL

(Not used)

VENTILATION AIR RECLAIM

(Not used)

HUMIDITY CONTROL

(Not used)

****

7. MISCELLANEOUS SYSTEM DATA

Cooling coil bypass factor	=	0.050
Type of supplemental heating	=	1 Not Used

****

AIR SYSTEM SPACE LIST

Name : #203 03-14-94

Carrier Hourly Analysis Program 6063092204

Prepared By : E.A.C., P.C. Burke, VA

Space Name	Qty.	Space Name	Qty.
TABLE 1. SPACES IN ZONE 1			
8 203	x 1		

PLANT DESCRIPTIONS

Plant : #204 — 03-14-94

Prepared By : E.A.C., P.C. Burke, VA — 6063092204

Carrier Hourly Analysis Program —

****

1 PLANT NAME AND TYPES

Class	= Heat Pumps
Name	= #204
Heat Pump Type	= Air Source Heat Pump
Auxiliary Plant Type	= Electrical Resistance

****

2 AIR SYSTEM SELECTION

Air System Name	Mult	Air System Name	Mult
#204	1		

****

3 PLANT CHARACTERISTICS (Air Source Heat Pump)

COOLING DATA

Estimated maximum cooling coil load	=	0.83 Ton
Capacity at 95.0 F outdoor air	=	0.96 Ton
Input power rate at 95.0 F outdoor air	=	1.375 kW/Ton

HEATING DATA

Estimated maximum heating coil load	=	7.09 MBH
Capacity at 47.0 F outdoor air	=	11.6 MBH
Compressor, evaporator fan kW at 47.0 F outdoor air	=	3.6 kW
Outdoor air temperature for cutoff	=	42.0 F

AUXILIARY PLANT DATA

Plant type	=	Electrical
Estimated maximum heating coil load	=	7.09 MBH
Type of heating	=	Direct

****

4 PUMP SYSTEM DATA

(No inputs required)

****

1. SYSTEM NAME AND TYPE

System Name = #204
System Class = Constant Volume
System Type = (SZCV) Single Zone Constant Volume
Operation Type = 3 Cooling & Heating
Type of Heating = 1 Central Heating

2. SPACE SELECTION (see separate printout)

3. THERMOSTAT & EQUIPMENT SCHEDULING DATA

Operation Period	Thermostat Setpoints Cooling	Heating	Ventilation Dampers
Occupied	78.0 F	70.0 F	OPEN
Unoccupied	78.0 F	70.0 F	CLOSED

Weekday	: Occupied Period Begins at 0	; Duration	= 24 hrs
Saturday	: Occupied Period Begins at 0	; Duration	= 24 hrs
Sunday	: Occupied Period Begins at 0	; Duration	= 24 hrs
Design Day	: Occupied Period Begins at 0	; Duration	= 24 hrs

4. SUPPLY, VENTILATION, RETURN AIR DATA

SUPPLY AIR
Supply air temperature = 55.0 F
Heating supply temperature = 100.0 F
Fan operation for heating = 2 Cycled

VENTILATION AIR
Nominal ventilation flow rate = 10.00 % of supply air
Minimum ventilation flow rate = 10.00 % of supply air
Damper leak rate = 5 % of vent air

RETURN AIR
Zone exhaust air flow rate = 0.00 CFM
Zone exhaust fan power = 0.0 kW
Is a return plenum used ? N

****
5. FAN DATA
SUPPLY FAN
Type = 2:Forward curved
Static = 0.50 in wg
Efficiency = 54 %
Configuration = 1 Draw-thru
RETURN FAN
Type = 1:(Fan does not exist)
****
6. ACCESSORY DEVICES AND SYSTEMS
PREHEAT COIL
(Not used)
OUTDOOR AIR ECONOMIZER CONTROL
(Not used)
VENTILATION AIR RECLAIM
(Not used)
HUMIDITY CONTROL
(Not used)
****
7. MISCELLANEOUS SYSTEM DATA
Cooling coil bypass factor = 0.050
Type of supplemental heating = 1 Not Used
****

AIR SYSTEM SPACE LIST

Name : #204 03-14-94
Carrier Hourly Analysis Program 6063092204
Prepared By : E.A.C., P.C. Burke, VA Page 1

Space Name	Qty.	Space Name	Qty.
TABLE 1. SPACES IN ZONE 1			
9 204	x 1		

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PLANT DESCRIPTIONS

Plant : #205 03-14-94
Prepared By : E.A.C., P.C. Burke, VA 6063092204
Carrier Hourly Analysis Program

1 PLANT NAME AND TYPES

Class = Heat Pumps
Name = #205
Heat Pump Type = Air Source Heat Pump
Auxiliary Plant Type = Electrical Resistance

2 AIR SYSTEM SELECTION

Air System Name	Mult	Air System Name	Mult
#205	1		

3 PLANT CHARACTERISTICS (Air Source Heat Pump)

COOLING DATA
Estimated maximum cooling coil load = 0.62 Ton
Capacity at 95.0 F outdoor air = 0.96 Ton
Input power rate at 95.0 F outdoor air = 1.375 kW/Ton

HEATING DATA
Estimated maximum heating coil load = 7.82 MBH
Capacity at 47.0 F outdoor air = 11.6 MBH
Compressor, evaporator fan kW at 47.0 F outdoor air = 3.6 kW
Outdoor air temperature for cutoff = 42.0 F

AUXILIARY PLANT DATA
Plant type = Electrical
Estimated maximum heating coil load = 7.82 MBH
Type of heating = Direct

4 PUMP SYSTEM DATA
(No inputs required)

AIR SYSTEM DESCRIPTION

Name : #205 | 03-14-94
Carrier Hourly Analysis Program | 6063092204
Prepared By : E.A.C., P.C. Burke, VA | Page 1 of 2

****

1. SYSTEM NAME AND TYPE

System Name = #205
System Class = Constant Volume
System Type = (SZCV) Single Zone Constant Volume
Operation Type = 3 Cooling & Heating
Type of Heating = 1 Central Heating

****

2. SPACE SELECTION (see separate printout)

****

3. THERMOSTAT & EQUIPMENT SCHEDULING DATA

Operation Period	Thermostat Setpoints Cooling	Thermostat Setpoints Heating	Ventilation Dampers
Occupied	78.0 F	70.0 F	OPEN
Unoccupied	78.0 F	70.0 F	CLOSED

Weekday	: Occupied Period Begins at 0	; Duration	= 24 hrs
Saturday	: Occupied Period Begins at 0	; Duration	= 24 hrs
Sunday	: Occupied Period Begins at 0	; Duration	= 24 hrs
Design Day	: Occupied Period Begins at 0	; Duration	= 24 hrs

****

4. SUPPLY, VENTILATION, RETURN AIR DATA

SUPPLY AIR
Supply air temperature = 55.0 F
Heating supply temperature = 100.0 F
Fan operation for heating = 2 Cycled

VENTILATION AIR
Nominal ventilation flow rate = 10.00 % of supply air
Minimum ventilation flow rate = 10.00 % of supply air
Damper leak rate = 5 % of vent air

RETURN AIR
Zone exhaust air flow rate = 0.00 CFM
Zone exhaust fan power = 0.0 kW
Is a return plenum used ? N

****

344

AIR SYSTEM DESCRIPTION

****

5. FAN DATA

SUPPLY FAN

Type	=	2:Forward curved
Static	=	0.50 in wg
Efficiency	=	54 %
Configuration	=	1 Draw-thru

RETURN FAN

Type	=	1:(Fan does not exist)

****

6. ACCESSORY DEVICES AND SYSTEMS

PREHEAT COIL
(Not used)

OUTDOOR AIR ECONOMIZER CONTROL
(Not used)

VENTILATION AIR RECLAIM
(Not used)

HUMIDITY CONTROL
(Not used)

****

7. MISCELLANEOUS SYSTEM DATA

Cooling coil bypass factor	=	0.050
Type of supplemental heating	=	1 Not Used

****

AIR SYSTEM SPACE LIST

Name : #205 03-14-94

Carrier Hourly Analysis Program 6063092204

Prepared By : E.A.C., P.C. Burke, VA

Space Name	Qty.	Space Name	Qty.
TABLE 1. SPACES IN ZONE 1			
10 205	x 1		

PLANT DESCRIPTIONS

Plant : #206 03-14-94

Prepared By : E.A.C., P.C. Burke, VA 6063092204

Carrier Hourly Analysis Program

****

1 PLANT NAME AND TYPES

Class	= Heat Pumps
Name	= #206
Heat Pump Type	= Air Source Heat Pump
Auxiliary Plant Type	= Electrical Resistance

****

2 AIR SYSTEM SELECTION

Air System Name	Mult	Air System Name	Mult
#206	1		

****

3 PLANT CHARACTERISTICS (Air Source Heat Pump)

COOLING DATA

Estimated maximum cooling coil load	= 0.61 Ton
Capacity at 95.0 F outdoor air	= 0.96 Ton
Input power rate at 95.0 F outdoor air	= 1.375 kW/Ton

HEATING DATA

Estimated maximum heating coil load	= 7.82 MBH
Capacity at 47.0 F outdoor air	= 11.6 MBH
Compressor, evaporator fan kW at 47.0 F outdoor air	= 3.6 kW
Outdoor air temperature for cutoff	= 42.0 F

AUXILIARY PLANT DATA

Plant type	= Electrical
Estimated maximum heating coil load	= 7.82 MBH
Type of heating	= Direct

****

4 PUMP SYSTEM DATA

(No inputs required)

****

AIR SYSTEM DESCRIPTION

Name : #206 03-14-94
Carrier Hourly Analysis Program 6063092204
Prepared By : E.A.C., P.C. Burke, VA

****

1. SYSTEM NAME AND TYPE

System Name = #206
System Class = Constant Volume
System Type = (SZCV) Single Zone Constant Volume
Operation Type = 3 Cooling & Heating
Type of Heating = 1 Central Heating

****

2. SPACE SELECTION (see separate printout)

****

3. THERMOSTAT & EQUIPMENT SCHEDULING DATA

Operation Period	Thermostat Setpoints Cooling	Thermostat Setpoints Heating	Ventilation Dampers
Occupied	78.0 F	70.0 F	OPEN
Unoccupied	78.0 F	70.0 F	CLOSED

Weekday	: Occupied Period Begins at	0	; Duration	= 24 hrs
Saturday	: Occupied Period Begins at	0	; Duration	= 24 hrs
Sunday	: Occupied Period Begins at	0	; Duration	= 24 hrs
Design Day	: Occupied Period Begins at	0	; Duration	= 24 hrs

****

4. SUPPLY, VENTILATION, RETURN AIR DATA

SUPPLY AIR
Supply air temperature = 55.0 F
Heating supply temperature = 100.0 F
Fan operation for heating = 2 Cycled

VENTILATION AIR
Nominal ventilation flow rate = 10.00 % of supply air
Minimum ventilation flow rate = 10.00 % of supply air
Damper leak rate = 5 % of vent air

RETURN AIR
Zone exhaust air flow rate = 0.00 CFM
Zone exhaust fan power = 0.0 kW
Is a return plenum used ? N

****

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AIR SYSTEM DESCRIPTION

Name : #206 03-14-94
Carrier Hourly Analysis Program 6063092204
Prepared By : E.A.C., P.C. Burke, VA

****

5. FAN DATA

SUPPLY FAN

Type	=	2:Forward curved
Static	=	0.50 in wg
Efficiency	=	54 %
Configuration	=	1 Draw-thru

RETURN FAN

Type	=	1:(Fan does not exist)

****

6. ACCESSORY DEVICES AND SYSTEMS

PREHEAT COIL
(Not used)

OUTDOOR AIR ECONOMIZER CONTROL
(Not used)

VENTILATION AIR RECLAIM
(Not used)

HUMIDITY CONTROL
(Not used)

****

7. MISCELLANEOUS SYSTEM DATA

Cooling coil bypass factor	=	0.050
Type of supplemental heating	=	1 Not Used

****

AIR SYSTEM SPACE LIST

Name : #206 03-14-94
Carrier Hourly Analysis Program 6063092204
Prepared By : E.A.C., P.C. Burke, VA Page 1

Space Name	Qty.	Space Name	Qty.
TABLE 1. SPACES IN ZONE 1			
11 206	x 1		

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COMPLEX SPACE DESCRIPTION

Space Name : REC ROOM BSMT | 03-14-94
Prepared By : E.A.C., P.C. Burke, VA | 6063092204
Carrier Hourly Analysis Program |

****

1. SPACE NAME = REC ROOM BSMT

****

2. WALL INFORMATION (Number of Wall Types = 2)

	Weight (lb/sqft)	Ext Color (D,M,L)	U-Value (BTU/hr/sqft/F)
Wall Type 1	M	D	0.469
Wall Type 2	M	D	0.290

Exposure	<-------- Net Wall Areas (sqft) --------> Wall Type 1	Wall Type 2	Wall Type 3
NE	254.0	42.0	NA
E	0.0	0.0	NA
SE	257.0	0.0	NA
S	0.0	0.0	NA
SW	0.0	0.0	NA
W	0.0	0.0	NA
NW	0.0	0.0	NA
N	0.0	0.0	NA

****

3. ROOF INFORMATION (Number of Roof Types = 1)

	Weight (lb/sqft)	Ext Color (D,M,L)	U-Value (BTU/hr/sqft/F)	Area (sqft)
Roof 1	L	D	0.030	0.0

****

4. GLASS INFORMATION (Number of Glass Types = 1)

	U-Value (BTU/hr/sqft/F)	Glass Factor	Internal Shades
Glass Type 1	0.690	0.65	Y

	<---- External Shading Information ----> Window Height (ft)	Window Width (ft)	Reveal Depth (in)	Overhang Height (in)	Overhang Extension (in)	Fin Separation (in)	Fin Exten. (in)
Shade 1	4.0	4.0	3.0	44.0	60.0	0.0	0.0
Shade 2	8.0	4.0	0.0	0.0	0.0	0.0	0.0
Shade 3	8.0	4.0	0.0	0.0	0.0	0.0	0.0

****

COMPLEX SPACE DESCRIPTION

Space Name : REC ROOM BSMT 03-14-94
Prepared By : E.A.C., P.C. Burke, VA 6063092204
Carrier Hourly Analysis Program

4. GLASS INFORMATION (continued)

	Glass Areas (sqft)					
	Type 1		Type 2		Type 3	
Exposure	Area	Shade	Area	Shade	Area	Shade
NE	40.0	1	NA	NA	NA	NA
E	0.0	0	NA	NA	NA	NA
SE	0.0	0	NA	NA	NA	NA
S	0.0	0	NA	NA	NA	NA
SW	0.0	0	NA	NA	NA	NA
W	0.0	0	NA	NA	NA	NA
NW	0.0	0	NA	NA	NA	NA
N	0.0	0	NA	NA	NA	NA
H	0.0	0	NA	NA	NA	NA

5. INTERNAL LOADS

SPACE DATA : Floor Area = 1,925 sqft Building Wt. = M lb/sqft

PEOPLE : sqft/person = 128.3 Total People = 15
Schedule No. = 1 Activity Level = 3

LIGHTING : W/sqft = 1.41 Total Watts = 2,720
Schedule No. = 1 Wattage Mult. = 1.25
Fixture Type = 1 Recessed, not vented

OTHER ELECTRIC: W/sqft = 0.00 Total Watts = 0
Schedule No. = 1

MISC. SENSIBLE: Load = 0 BTU/hr Schedule No. = 1
MISC. LATENT : Load = 0 BTU/hr Schedule No. = 1

6. PARTITIONS, INFILTRATION, GROUND

PARTITIONS (Next to Unconditioned Spaces)	Area (sqft)	U-Value (BTU/hr/sqft/F)	Unconditioned Space Temp. Cooling (deg F or %)	Unconditioned Space Temp. Heating (deg F or %)
Walls	0.0	0.100	90.0 F	55.0 F
Ceilings	0.0	0.100	90.0 F	50.0 F
Floors	0.0	0.100	90.0 F	50.0 F

INFILTRATION
Cooling : 0.10 CFM/sqft = 193 CFM
Heating : 0.15 CFM/sqft = 289 CFM
Typical : 0.15 CFM/sqft = 289 CFM

GROUND ELEMENT
Area : 1,900.0 sqft
Perimeter : 100.0 ft
Depth : 10.0 ft

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COMPLEX SPACE DESCRIPTION

Space Name : SUPPLY BSMT — 03-14-94
Prepared By : E.A.C., P.C. Burke, VA — 6063092204
Carrier Hourly Analysis Program —

***

1. SPACE NAME = SUPPLY BSMT

***

2. WALL INFORMATION (Number of Wall Types = 1)

	Weight (lb/sqft)	Ext Color (D,M,L)	U-Value (BTU/hr/sqft/F)
Wall Type 1	M	D	0.469

	<-------- Net Wall Areas (sqft) -------->		
Exposure	Wall Type 1	Wall Type 2	Wall Type 3
NE	0.0	NA	NA
E	0.0	NA	NA
SE	0.0	NA	NA
S	0.0	NA	NA
SW	0.0	NA	NA
W	0.0	NA	NA
NW	0.0	NA	NA
N	0.0	NA	NA

***

3. ROOF INFORMATION (Number of Roof Types = 1)

	Weight (lb/sqft)	Ext Color (D,M,L)	U-Value (BTU/hr/sqft/F)	Area (sqft)
Roof 1	M	D	0.030	0.0

***

4. GLASS INFORMATION (Number of Glass Types = 1)

	U-Value (BTU/hr/sqft/F)	Glass Factor	Internal Shades
Glass Type 1	0.690	0.65	Y

	<---------------- External Shading Information ---------------->						
	Window Height (ft)	Window Width (ft)	Reveal Depth (in)	Overhang Height (in)	Overhang Extension (in)	Fin Separation (in)	Fin Exten. (in)
Shade 1	4.0	4.0	3.0	44.0	60.0	0.0	0.0
Shade 2	8.0	4.0	0.0	0.0	0.0	0.0	0.0
Shade 3	8.0	4.0	0.0	0.0	0.0	0.0	0.0

***

COMPLEX SPACE DESCRIPTION

4. GLASS INFORMATION (continued)

	Glass Areas (sqft)					
	Type 1		Type 2		Type 3	
Exposure	Area	Shade	Area	Shade	Area	Shade
NE	0.0	0	NA	NA	NA	NA
E	0.0	0	NA	NA	NA	NA
SE	0.0	0	NA	NA	NA	NA
S	0.0	0	NA	NA	NA	NA
SW	0.0	0	NA	NA	NA	NA
W	0.0	0	NA	NA	NA	NA
NW	0.0	0	NA	NA	NA	NA
N	0.0	0	NA	NA	NA	NA
H	0.0	0	NA	NA	NA	NA

5. INTERNAL LOADS

SPACE DATA	: Floor Area	= 120 sqft	Building Wt.	=	M lb/sqft
PEOPLE	: sqft/person	= 0.0	Total People	=	0
	Schedule No.	= 1	Activity Level	=	1
LIGHTING	: W/sqft	= 2.67	Total Watts	=	320
	Schedule No.	= 1	Wattage Mult.	=	1.25
	Fixture Type	= 1 Recessed, not vented			
OTHER ELECTRIC:	W/sqft	= 0.00	Total Watts	=	0
	Schedule No.	= 1			
MISC. SENSIBLE:	Load	= 0 BTU/hr	Schedule No.	=	1
MISC. LATENT :	Load	= 0 BTU/hr	Schedule No.	=	1

6. PARTITIONS, INFILTRATION, GROUND

PARTITIONS (Next to Unconditioned Spaces)	Area (sqft)	U-Value (BTU/hr/sqft/F)	Unconditioned Space Temp. Cooling (deg F or %)	Heating (deg F or %)
Walls	0.0	0.100	90.0 F	55.0 F
Ceilings	0.0	0.100	90.0 F	50.0 F
Floors	0.0	0.100	90.0 F	50.0 F

INFILTRATION			GROUND ELEMENT	
Cooling	: 0.10 CFM/sqft =	12 CFM	Area :	120.0 sqft
Heating	: 0.15 CFM/sqft =	18 CFM	Perimeter :	7.5 ft
Typical	: 0.15 CFM/sqft =	18 CFM	Depth :	10.0 ft

1. SPACE NAME = MENS BSMT

2. WALL INFORMATION (Number of Wall Types = 1)

	Weight (lb/sqft)	Ext Color (D,M,L)	U-Value (BTU/hr/sqft/F)
Wall Type 1	M	D	0.469

Exposure	<-------- Net Wall Areas (sqft) --------> Wall Type 1	Wall Type 2	Wall Type 3
NE	0.0	NA	NA
E	0.0	NA	NA
SE	0.0	NA	NA
S	0.0	NA	NA
SW	0.0	NA	NA
W	0.0	NA	NA
NW	60.0	NA	NA
N	0.0	NA	NA

3. ROOF INFORMATION (Number of Roof Types = 1)

	Weight (lb/sqft)	Ext Color (D,M,L)	U-Value (BTU/hr/sqft/F)	Area (sqft)
Roof 1	M	D	0.030	0.0

4. GLASS INFORMATION (Number of Glass Types = 1)

	U-Value (BTU/hr/sqft/F)	Glass Factor	Internal Shades
Glass Type 1	0.690	0.65	Y

	<---------------- External Shading Information ---------------->						
	Window Height (ft)	Window Width (ft)	Reveal Depth (in)	Overhang Height (in)	Overhang Extension (in)	Fin Separation (in)	Fin Exten. (in)
Shade 1	4.0	4.0	3.0	44.0	60.0	0.0	0.0
Shade 2	8.0	4.0	0.0	0.0	0.0	0.0	0.0
Shade 3	8.0	4.0	0.0	0.0	0.0	0.0	0.0

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COMPLEX SPACE DESCRIPTION

Space Name : MENS BSMT 03-14-94
Prepared By : E.A.C., P.C. Burke, VA 6063092204
Carrier Hourly Analysis Program

4. GLASS INFORMATION (continued)

Exposure	Type 1 Area	Type 1 Shade	Type 2 Area	Type 2 Shade	Type 3 Area	Type 3 Shade
	Glass Areas (sqft)					
NE	0.0	0	NA	NA	NA	NA
E	0.0	0	NA	NA	NA	NA
SE	0.0	0	NA	NA	NA	NA
S	0.0	0	NA	NA	NA	NA
SW	0.0	0	NA	NA	NA	NA
W	0.0	0	NA	NA	NA	NA
NW	0.0	0	NA	NA	NA	NA
N	0.0	0	NA	NA	NA	NA
H	0.0	0	NA	NA	NA	NA

5. INTERNAL LOADS

SPACE DATA : Floor Area = 42 sqft Building Wt. = M lb/sqft

PEOPLE : sqft/person = 42.0 Total People = 1
Schedule No. = 1 Activity Level = 1

LIGHTING : W/sqft = 1.43 Total Watts = 60
Schedule No. = 1 Wattage Mult. = 1.00
Fixture Type = 1 Recessed, not vented

OTHER ELECTRIC: W/sqft = 0.00 Total Watts = 0
Schedule No. = 1

MISC. SENSIBLE: Load = 0 BTU/hr Schedule No. = 1
MISC. LATENT : Load = 0 BTU/hr Schedule No. = 1

6. PARTITIONS, INFILTRATION, GROUND

PARTITIONS (Next to Unconditioned Spaces)	Area (sqft)	U-Value (BTU/hr/sqft/F)	Unconditioned Space Temp. Cooling (deg F or %)	Unconditioned Space Temp. Heating (deg F or %)
Walls	0.0	0.100	90.0 F	55.0 F
Ceilings	0.0	0.100	90.0 F	50.0 F
Floors	0.0	0.100	90.0 F	50.0 F

INFILTRATION			GROUND ELEMENT	
Cooling	: 0.10 CFM/sqft =	4 CFM	Area :	42.0 sqft
Heating	: 0.15 CFM/sqft =	6 CFM	Perimeter :	6.0 ft
Typical	: 0.15 CFM/sqft =	6 CFM	Depth :	10.0 ft

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COMPLEX SPACE DESCRIPTION

Space Name : LADIES BSMT — 03-14-94
Prepared By : E.A.C., P.C. Burke, VA — 6063092204
Carrier Hourly Analysis Program

1. SPACE NAME = LADIES BSMT

2. WALL INFORMATION (Number of Wall Types = 1)

	Weight (lb/sqft)	Ext Color (D,M,L)	U-Value (BTU/hr/sqft/F)
Wall Type 1	M	D	0.469

	<-------- Net Wall Areas (sqft) -------->		
Exposure	Wall Type 1	Wall Type 2	Wall Type 3
NE	0.0	NA	NA
E	0.0	NA	NA
SE	0.0	NA	NA
S	0.0	NA	NA
SW	0.0	NA	NA
W	0.0	NA	NA
NW	0.0	NA	NA
N	0.0	NA	NA

3. ROOF INFORMATION (Number of Roof Types = 1)

	Weight (lb/sqft)	Ext Color (D,M,L)	U-Value (BTU/hr/sqft/F)	Area (sqft)
Roof 1	M	D	0.030	0.0

4. GLASS INFORMATION (Number of Glass Types = 1)

	U-Value (BTU/hr/sqft/F)	Glass Factor	Internal Shades
Glass Type 1	0.690	0.65	Y

	<---------------- External Shading Information ---------------->						
	Window Height (ft)	Window Width (ft)	Reveal Depth (in)	Overhang Height (in)	Overhang Extension (in)	Fin Separation (in)	Fin Exten. (in)
Shade 1	4.0	4.0	3.0	44.0	60.0	0.0	0.0
Shade 2	8.0	4.0	0.0	0.0	0.0	0.0	0.0
Shade 3	8.0	4.0	0.0	0.0	0.0	0.0	0.0

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COMPLEX SPACE DESCRIPTION

Space Name : LADIES BSMT 03-14-94
Prepared By : E.A.C., P.C. Burke, VA 6063092204
Carrier Hourly Analysis Program

4. GLASS INFORMATION (continued)

Exposure	Type 1 Area	Type 1 Shade	Type 2 Area	Type 2 Shade	Type 3 Area	Type 3 Shade
	<------- Glass Areas (sqft) ------->					
NE	0.0	0	NA	NA	NA	NA
E	0.0	0	NA	NA	NA	NA
SE	0.0	0	NA	NA	NA	NA
S	0.0	0	NA	NA	NA	NA
SW	0.0	0	NA	NA	NA	NA
W	0.0	0	NA	NA	NA	NA
NW	0.0	0	NA	NA	NA	NA
N	0.0	0	NA	NA	NA	NA
H	0.0	0	NA	NA	NA	NA

5. INTERNAL LOADS

SPACE DATA : Floor Area = 42 sqft Building Wt. = M lb/sqft

PEOPLE : sqft/person = 42.0 Total People = 1
Schedule No. = 1 Activity Level = 1

LIGHTING : W/sqft = 1.43 Total Watts = 60
Schedule No. = 1 Wattage Mult. = 1.00
Fixture Type = 1 Recessed, not vented

OTHER ELECTRIC: W/sqft = 0.00 Total Watts = 0
Schedule No. = 1

MISC. SENSIBLE: Load = 0 BTU/hr Schedule No. = 1
MISC. LATENT : Load = 0 BTU/hr Schedule No. = 1

6. PARTITIONS, INFILTRATION, GROUND

PARTITIONS (Next to Unconditioned Spaces)	Area (sqft)	U-Value (BTU/hr/sqft/F)	Unconditioned Space Temp. Cooling (deg F or %)	Unconditioned Space Temp. Heating (deg F or %)
Walls	0.0	0.100	90.0 F	55.0 F
Ceilings	0.0	0.100	90.0 F	50.0 F
Floors	0.0	0.100	90.0 F	50.0 F

INFILTRATION			GROUND ELEMENT	
Cooling	: 0.10 CFM/sqft =	4 CFM	Area :	42.0 sqft
Heating	: 0.15 CFM/sqft =	6 CFM	Perimeter :	0.0 ft
Typical	: 0.15 CFM/sqft =	6 CFM	Depth :	10.0 ft

COMPLEX SPACE DESCRIPTION

Space Name : LAUNDRY BSMT — 03-14-94
Prepared By : E.A.C., P.C. Burke, VA — 6063092204
Carrier Hourly Analysis Program —

1. SPACE NAME = LAUNDRY BSMT

2. WALL INFORMATION (Number of Wall Types = 2)

	Weight (lb/sqft)	Ext Color (D,M,L)	U-Value (BTU/hr/sqft/F)
Wall Type 1	M	D	0.469
Wall Type 2	M	L	0.290

Exposure	Net Wall Areas (sqft) Wall Type 1	Wall Type 2	Wall Type 3
NE	63.0	21.0	NA
E	0.0	0.0	NA
SE	0.0	0.0	NA
S	0.0	0.0	NA
SW	0.0	0.0	NA
W	0.0	0.0	NA
NW	185.0	0.0	NA
N	0.0	0.0	NA

3. ROOF INFORMATION (Number of Roof Types = 1)

	Weight (lb/sqft)	Ext Color (D,M,L)	U-Value (BTU/hr/sqft/F)	Area (sqft)
Roof 1	M	D	0.030	0.0

4. GLASS INFORMATION (Number of Glass Types = 1)

	U-Value (BTU/hr/sqft/F)	Glass Factor	Internal Shades
Glass Type 1	0.690	0.65	Y

	External Shading Information Window Height (ft)	Window Width (ft)	Reveal Depth (in)	Overhang Height (in)	Overhang Extension (in)	Fin Separation (in)	Fin Exten. (in)
Shade 1	4.0	4.0	3.0	44.0	60.0	0.0	0.0
Shade 2	8.0	4.0	0.0	0.0	0.0	0.0	0.0
Shade 3	8.0	4.0	0.0	0.0	0.0	0.0	0.0

****

4. GLASS INFORMATION (continued)

	Glass Areas (sqft)					
	Type 1		Type 2		Type 3	
Exposure	Area	Shade	Area	Shade	Area	Shade
NE	0.0	0	NA	NA	NA	NA
E	0.0	0	NA	NA	NA	NA
SE	0.0	0	NA	NA	NA	NA
S	0.0	0	NA	NA	NA	NA
SW	0.0	0	NA	NA	NA	NA
W	0.0	0	NA	NA	NA	NA
NW	0.0	0	NA	NA	NA	NA
N	0.0	0	NA	NA	NA	NA
H	0.0	0	NA	NA	NA	NA

****

5. INTERNAL LOADS

SPACE DATA : Floor Area = 116 sqft Building Wt. = M lb/sqft

PEOPLE : sqft/person = 58.0 Total People = 2
Schedule No. = 1 Activity Level = 5

LIGHTING : W/sqft = 2.76 Total Watts = 320
Schedule No. = 1 Wattage Mult. = 1.25
Fixture Type = 1 Recessed, not vented

OTHER ELECTRIC: W/sqft = 0.00 Total Watts = 0
Schedule No. = 1

MISC. SENSIBLE: Load = 0 BTU/hr Schedule No. = 1
MISC. LATENT : Load = 0 BTU/hr Schedule No. = 1

****

6. PARTITIONS, INFILTRATION, GROUND

PARTITIONS (Next to Unconditioned Spaces)	Area (sqft)	U-Value (BTU/hr/sqft/F)	Unconditioned Space Temp. Cooling (deg F or %)	Heating (deg F or %)
Walls	0.0	0.100	90.0 F	55.0 F
Ceilings	0.0	0.100	90.0 F	50.0 F
Floors	0.0	0.100	90.0 F	50.0 F

INFILTRATION			GROUND ELEMENT	
Cooling	: 0.10 CFM/sqft =	12 CFM	Area :	116.0 sqft
Heating	: 0.15 CFM/sqft =	17 CFM	Perimeter :	0.0 ft
Typical	: 0.15 CFM/sqft =	17 CFM	Depth :	10.0 ft

****

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1. SPACE NAME = 201

2. WALL INFORMATION (Number of Wall Types = 2)

	Weight (lb/sqft)	Ext Color (D,M,L)	U-Value (BTU/hr/sqft/F)
Wall Type 1	M	D	0.070
Wall Type 2	M	L	0.290

Exposure	<-------- Net Wall Areas (sqft) --------> Wall Type 1	Wall Type 2	Wall Type 3
NE	128.0	21.0	NA
E	0.0	0.0	NA
SE	192.0	0.0	NA
S	0.0	0.0	NA
SW	0.0	0.0	NA
W	0.0	0.0	NA
NW	0.0	0.0	NA
N	0.0	0.0	NA

3. ROOF INFORMATION (Number of Roof Types = 1)

	Weight (lb/sqft)	Ext Color (D,M,L)	U-Value (BTU/hr/sqft/F)	Area (sqft)
Roof 1	L	D	0.030	416.0

4. GLASS INFORMATION (Number of Glass Types = 1)

	U-Value (BTU/hr/sqft/F)	Glass Factor	Internal Shades
Glass Type 1	0.690	0.65	Y

	<------ External Shading Information ------> Window Height (ft)	Window Width (ft)	Reveal Depth (in)	Overhang Height (in)	Overhang Extension (in)	Fin Separation (in)	Fin Exten. (in)
Shade 1	4.0	4.0	3.0	44.0	60.0	0.0	0.0
Shade 2	8.0	4.0	0.0	0.0	0.0	0.0	0.0
Shade 3	8.0	4.0	0.0	0.0	0.0	0.0	0.0

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4. GLASS INFORMATION (continued)

	Glass Areas (sqft)					
	Type 1		Type 2		Type 3	
Exposure	Area	Shade	Area	Shade	Area	Shade
NE	76.0	1	NA	NA	NA	NA
E	0.0	0	NA	NA	NA	NA
SE	0.0	0	NA	NA	NA	NA
S	0.0	0	NA	NA	NA	NA
SW	0.0	0	NA	NA	NA	NA
W	0.0	0	NA	NA	NA	NA
NW	0.0	0	NA	NA	NA	NA
N	0.0	0	NA	NA	NA	NA
H	0.0	0	NA	NA	NA	NA

****

5. INTERNAL LOADS

SPACE DATA : Floor Area = 384 sqft Building Wt. = M lb/sqft

PEOPLE : sqft/person = 192.0 Total People = 2
Schedule No. = 3 Activity Level = 1

LIGHTING : W/sqft = 0.83 Total Watts = 320
Schedule No. = 3 Wattage Mult. = 1.25
Fixture Type = 1 Recessed, not vented

OTHER ELECTRIC: W/sqft = 2.11 Total Watts = 810
Schedule No. = 4

MISC. SENSIBLE: Load = 0 BTU/hr Schedule No. = 1
MISC. LATENT : Load = 0 BTU/hr Schedule No. = 1

****

6. PARTITIONS, INFILTRATION, GROUND

PARTITIONS (Next to Unconditioned Spaces)	Area (sqft)	U-Value (BTU/hr/sqft/F)	Unconditioned Space Temp. Cooling (deg F or %)	Heating (deg F or %)
Walls	0.0	0.100	90.0 F	55.0 F
Ceilings	0.0	0.100	90.0 F	50.0 F
Floors	0.0	0.100	90.0 F	50.0 F

INFILTRATION			GROUND ELEMENT	
Cooling	: 0.10 CFM/sqft =	38 CFM	Area :	0.0 sqft
Heating	: 0.15 CFM/sqft =	58 CFM	Perimeter :	0.0 ft
Typical	: 0.15 CFM/sqft =	58 CFM	Depth :	0.0 ft

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1. SPACE NAME = 202

2. WALL INFORMATION (Number of Wall Types = 2)

	Weight (lb/sqft)	Ext Color (D,M,L)	U-Value (BTU/hr/sqft/F)
Wall Type 1	M	D	0.070
Wall Type 2	M	L	0.290

Exposure	<-------- Net Wall Areas (sqft) --------> Wall Type 1	Wall Type 2	Wall Type 3
NE	0.0	0.0	NA
E	0.0	0.0	NA
SE	192.0	0.0	NA
S	0.0	0.0	NA
SW	128.0	21.0	NA
W	0.0	0.0	NA
NW	0.0	0.0	NA
N	0.0	0.0	NA

3. ROOF INFORMATION (Number of Roof Types = 1)

	Weight (lb/sqft)	Ext Color (D,M,L)	U-Value (BTU/hr/sqft/F)	Area (sqft)
Roof 1	L	D	0.030	416.0

4. GLASS INFORMATION (Number of Glass Types = 1)

	U-Value (BTU/hr/sqft/F)	Glass Factor	Internal Shades
Glass Type 1	0.690	0.65	Y

	<---------------- External Shading Information ---------------->						
	Window Height (ft)	Window Width (ft)	Reveal Depth (in)	Overhang Height (in)	Overhang Extension (in)	Fin Separation (in)	Fin Exten. (in)
Shade 1	4.0	4.0	3.0	12.0	60.0	0.0	0.0
Shade 2	8.0	4.0	0.0	0.0	0.0	0.0	0.0
Shade 3	8.0	4.0	0.0	0.0	0.0	0.0	0.0

COMPLEX SPACE DESCRIPTION

Space Name : 202 03-14-94
Prepared By : E.A.C., P.C. Burke, VA 6063092204
Carrier Hourly Analysis Program

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4. GLASS INFORMATION (continued)

	Glass Areas (sqft)					
	Type 1		Type 2		Type 3	
Exposure	Area	Shade	Area	Shade	Area	Shade
NE	0.0	0	NA	NA	NA	NA
E	0.0	0	NA	NA	NA	NA
SE	0.0	0	NA	NA	NA	NA
S	0.0	0	NA	NA	NA	NA
SW	76.0	1	NA	NA	NA	NA
W	0.0	0	NA	NA	NA	NA
NW	0.0	0	NA	NA	NA	NA
N	0.0	0	NA	NA	NA	NA
H	0.0	0	NA	NA	NA	NA

****

5. INTERNAL LOADS

SPACE DATA : Floor Area = 384 sqft Building Wt. = M lb/sqft

PEOPLE : sqft/person = 192.0 Total People = 2
Schedule No. = 3 Activity Level = 1

LIGHTING : W/sqft = 0.83 Total Watts = 320
Schedule No. = 3 Wattage Mult. = 1.25
Fixture Type = 1 Recessed, not vented

OTHER ELECTRIC: W/sqft = 2.11 Total Watts = 810
Schedule No. = 4

MISC. SENSIBLE: Load = 0 BTU/hr Schedule No. = 1
MISC. LATENT : Load = 0 BTU/hr Schedule No. = 1

****

6. PARTITIONS, INFILTRATION, GROUND

PARTITIONS (Next to Unconditioned Spaces)	Area (sqft)	U-Value (BTU/hr/sqft/F)	Unconditioned Space Temp. Cooling (deg F or %)	Heating (deg F or %)
Walls	0.0	0.100	90.0 F	55.0 F
Ceilings	0.0	0.100	90.0 F	50.0 F
Floors	0.0	0.100	90.0 F	50.0 F

INFILTRATION			GROUND ELEMENT	
Cooling	: 0.10 CFM/sqft =	38 CFM	Area :	0.0 sqft
Heating	: 0.15 CFM/sqft =	58 CFM	Perimeter :	0.0 ft
Typical	: 0.15 CFM/sqft =	58 CFM	Depth :	0.0 ft

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COMPLEX SPACE DESCRIPTION

Space Name : 203 | 03-14-94
Prepared By : E.A.C., P.C. Burke, VA | 6063092204
Carrier Hourly Analysis Program |

1. SPACE NAME = 203

2. WALL INFORMATION (Number of Wall Types = 2)

	Weight (lb/sqft)	Ext Color (D,M,L)	U-Value (BTU/hr/sqft/F)
Wall Type 1	M	D	0.070
Wall Type 2	M	L	0.290

	<-------- Net Wall Areas (sqft) -------->		
Exposure	Wall Type 1	Wall Type 2	Wall Type 3
NE	128.0	21.0	NA
E	0.0	0.0	NA
SE	0.0	0.0	NA
S	0.0	0.0	NA
SW	0.0	0.0	NA
W	0.0	0.0	NA
NW	0.0	0.0	NA
N	0.0	0.0	NA

3. ROOF INFORMATION (Number of Roof Types = 1)

	Weight (lb/sqft)	Ext Color (D,M,L)	U-Value (BTU/hr/sqft/F)	Area (sqft)
Roof 1	L	D	0.030	416.0

4. GLASS INFORMATION (Number of Glass Types = 1)

	U-Value (BTU/hr/sqft/F)	Glass Factor	Internal Shades
Glass Type 1	0.690	0.65	Y

	<---------------- External Shading Information ---------------->						
	Window Height (ft)	Window Width (ft)	Reveal Depth (in)	Overhang Height (in)	Overhang Extension (in)	Fin Separation (in)	Fin Exten. (in)
Shade 1	4.0	4.0	3.0	12.0	60.0	0.0	0.0
Shade 2	8.0	4.0	0.0	0.0	0.0	0.0	0.0
Shade 3	8.0	4.0	0.0	0.0	0.0	0.0	0.0

COMPLEX SPACE DESCRIPTION

4. GLASS INFORMATION (continued)

	Glass Areas (sqft)					
	Type 1		Type 2		Type 3	
Exposure	Area	Shade	Area	Shade	Area	Shade
NE	76.0	1	NA	NA	NA	NA
E	0.0	0	NA	NA	NA	NA
SE	0.0	0	NA	NA	NA	NA
S	0.0	0	NA	NA	NA	NA
SW	0.0	0	NA	NA	NA	NA
W	0.0	0	NA	NA	NA	NA
NW	0.0	0	NA	NA	NA	NA
N	0.0	0	NA	NA	NA	NA
H	0.0	0	NA	NA	NA	NA

5. INTERNAL LOADS

SPACE DATA	: Floor Area	= 384 sqft	Building Wt.	=	M lb/sqft
PEOPLE	: sqft/person	= 192.0	Total People	=	2
	Schedule No.	= 3	Activity Level	=	1
LIGHTING	: W/sqft	= 0.83	Total Watts	=	320
	Schedule No.	= 3	Wattage Mult.	=	1.25
	Fixture Type	= 1	Recessed, not vented		
OTHER ELECTRIC:	W/sqft	= 2.11	Total Watts	=	810
	Schedule No.	= 4			
MISC. SENSIBLE:	Load	= 0 BTU/hr	Schedule No.	=	1
MISC. LATENT :	Load	= 0 BTU/hr	Schedule No.	=	1

6. PARTITIONS, INFILTRATION, GROUND

PARTITIONS (Next to Unconditioned Spaces)	Area (sqft)	U-Value (BTU/hr/sqft/F)	Unconditioned Space Temp. Cooling (deg F or %)	Heating (deg F or %)
Walls	0.0	0.100	90.0 F	55.0 F
Ceilings	0.0	0.100	90.0 F	50.0 F
Floors	0.0	0.100	90.0 F	50.0 F

INFILTRATION			GROUND ELEMENT	
Cooling	: 0.10 CFM/sqft =	38 CFM	Area :	0.0 sqft
Heating	: 0.15 CFM/sqft =	58 CFM	Perimeter :	0.0 ft
Typical	: 0.15 CFM/sqft =	58 CFM	Depth :	0.0 ft

COMPLEX SPACE DESCRIPTION

Space Name : 204 — 03-14-94
Prepared By : E.A.C., P.C.   Burke, VA — 6063092204
Carrier Hourly Analysis Program —

1. SPACE NAME = 204

2. WALL INFORMATION (Number of Wall Types = 2)

	Weight (lb/sqft)	Ext Color (D,M,L)	U-Value (BTU/hr/sqft/F)
Wall Type 1	M	D	0.070
Wall Type 2	M	L	0.290

	<-------- Net Wall Areas (sqft) -------->		
Exposure	Wall Type 1	Wall Type 2	Wall Type 3
NE	128.0	21.0	NA
E	0.0	0.0	NA
SE	0.0	0.0	NA
S	0.0	0.0	NA
SW	0.0	0.0	NA
W	0.0	0.0	NA
NW	0.0	0.0	NA
N	0.0	0.0	NA

3. ROOF INFORMATION (Number of Roof Types = 1)

	Weight (lb/sqft)	Ext Color (D,M,L)	U-Value (BTU/hr/sqft/F)	Area (sqft)
Roof 1	L	D	0.030	416.0

4. GLASS INFORMATION (Number of Glass Types = 1)

	U-Value (BTU/hr/sqft/F)	Glass Factor	Internal Shades
Glass Type 1	0.690	0.65	Y

	<---------------- External Shading Information ---------------->						
	Window Height (ft)	Window Width (ft)	Reveal Depth (in)	Overhang Height (in)	Overhang Extension (in)	Fin Separation (in)	Fin Exten. (in)
Shade 1	4.0	4.0	3.0	12.0	60.0	0.0	0.0
Shade 2	8.0	4.0	0.0	0.0	0.0	0.0	0.0
Shade 3	8.0	4.0	0.0	0.0	0.0	0.0	0.0

COMPLEX SPACE DESCRIPTION

Space Name : 204 | 03-14-94
Prepared By : E.A.C., P.C. Burke, VA | 6063092204
Carrier Hourly Analysis Program |

4. GLASS INFORMATION (continued)

	Glass Areas (sqft)					
	Type 1		Type 2		Type 3	
Exposure	Area	Shade	Area	Shade	Area	Shade
NE	0.0	0	NA	NA	NA	NA
E	0.0	0	NA	NA	NA	NA
SE	0.0	0	NA	NA	NA	NA
S	0.0	0	NA	NA	NA	NA
SW	76.0	1	NA	NA	NA	NA
W	0.0	0	NA	NA	NA	NA
NW	0.0	0	NA	NA	NA	NA
N	0.0	0	NA	NA	NA	NA
H	0.0	0	NA	NA	NA	NA

5. INTERNAL LOADS

SPACE DATA	Floor Area	=	384 sqft	Building Wt.	=	M lb/sqft
PEOPLE	sqft/person	=	192.0	Total People	=	2
	Schedule No.	=	3	Activity Level	=	1
LIGHTING	W/sqft	=	0.83	Total Watts	=	320
	Schedule No.	=	3	Wattage Mult.	=	1.25
	Fixture Type	=	1 Recessed, not vented			
OTHER ELECTRIC	W/sqft	=	2.11	Total Watts	=	810
	Schedule No.	=	4			
MISC. SENSIBLE	Load	=	0 BTU/hr	Schedule No.	=	1
MISC. LATENT	Load	=	0 BTU/hr	Schedule No.	=	1

6. PARTITIONS, INFILTRATION, GROUND

PARTITIONS (Next to Unconditioned Spaces)	Area (sqft)	U-Value (BTU/hr/sqft/F)	Unconditioned Space Temp. Cooling (deg F or %)	Unconditioned Space Temp. Heating (deg F or %)
Walls	0.0	0.100	90.0 F	55.0 F
Ceilings	0.0	0.100	90.0 F	50.0 F
Floors	0.0	0.100	90.0 F	50.0 F

INFILTRATION			GROUND ELEMENT	
Cooling	0.10 CFM/sqft =	38 CFM	Area :	0.0 sqft
Heating	0.15 CFM/sqft =	58 CFM	Perimeter :	0.0 ft
Typical	0.15 CFM/sqft =	58 CFM	Depth :	0.0 ft

1. SPACE NAME = 205

2. WALL INFORMATION (Number of Wall Types = 2)

	Weight (lb/sqft)	Ext Color (D,M,L)	U-Value (BTU/hr/sqft/F)
Wall Type 1	M	D	0.070
Wall Type 2	M	L	0.290

Exposure	<-------- Net Wall Areas (sqft) --------> Wall Type 1	Wall Type 2	Wall Type 3
NE	128.0	21.0	NA
E	0.0	0.0	NA
SE	0.0	0.0	NA
S	0.0	0.0	NA
SW	0.0	0.0	NA
W	0.0	0.0	NA
NW	192.0	0.0	NA
N	0.0	0.0	NA

3. ROOF INFORMATION (Number of Roof Types = 1)

	Weight (lb/sqft)	Ext Color (D,M,L)	U-Value (BTU/hr/sqft/F)	Area (sqft)
Roof 1	L	D	0.030	416.0

4. GLASS INFORMATION (Number of Glass Types = 1)

	U-Value (BTU/hr/sqft/F)	Glass Factor	Internal Shades
Glass Type 1	0.690	0.65	Y

<---------------- External Shading Information ---------------->

	Window Height (ft)	Window Width (ft)	Reveal Depth (in)	Overhang Height (in)	Overhang Extension (in)	Fin Separation (in)	Fin Exten. (in)
Shade 1	4.0	4.0	3.0	12.0	60.0	0.0	0.0
Shade 2	8.0	4.0	0.0	0.0	0.0	0.0	0.0
Shade 3	8.0	4.0	0.0	0.0	0.0	0.0	0.0

4. GLASS INFORMATION (continued)

	Glass Areas (sqft)					
	Type 1		Type 2		Type 3	
Exposure	Area	Shade	Area	Shade	Area	Shade
NE	76.0	1	NA	NA	NA	NA
E	0.0	0	NA	NA	NA	NA
SE	0.0	0	NA	NA	NA	NA
S	0.0	0	NA	NA	NA	NA
SW	0.0	0	NA	NA	NA	NA
W	0.0	0	NA	NA	NA	NA
NW	0.0	0	NA	NA	NA	NA
N	0.0	0	NA	NA	NA	NA
H	0.0	0	NA	NA	NA	NA

5. INTERNAL LOADS

SPACE DATA : Floor Area = 384 sqft Building Wt. = M lb/sqft

PEOPLE : sqft/person = 192.0 Total People = 2
Schedule No. = 3 Activity Level = 1

LIGHTING : W/sqft = 0.83 Total Watts = 320
Schedule No. = 3 Wattage Mult. = 1.25
Fixture Type = 1 Recessed, not vented

OTHER ELECTRIC: W/sqft = 2.11 Total Watts = 810
Schedule No. = 4

MISC. SENSIBLE: Load = 0 BTU/hr Schedule No. = 1
MISC. LATENT : Load = 0 BTU/hr Schedule No. = 1

6. PARTITIONS, INFILTRATION, GROUND

PARTITIONS (Next to Unconditioned Spaces)	Area (sqft)	U-Value (BTU/hr/sqft/F)	Unconditioned Space Temp. Cooling (deg F or %)	Heating (deg F or %)
Walls	0.0	0.100	90.0 F	55.0 F
Ceilings	0.0	0.100	90.0 F	50.0 F
Floors	0.0	0.100	90.0 F	50.0 F

INFILTRATION			GROUND ELEMENT	
Cooling	: 0.10 CFM/sqft =	38 CFM	Area :	0.0 sqft
Heating	: 0.15 CFM/sqft =	58 CFM	Perimeter :	0.0 ft
Typical	: 0.15 CFM/sqft =	58 CFM	Depth :	0.0 ft

COMPLEX SPACE DESCRIPTION

Space Name : 206 — 03-14-94

Prepared By : E.A.C., P.C. Burke, VA — 6063092204

Carrier Hourly Analysis Program —

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1. SPACE NAME = 206

****

2. WALL INFORMATION (Number of Wall Types = 2)

	Weight (lb/sqft)	Ext Color (D,M,L)	U-Value (BTU/hr/sqft/F)
Wall Type 1	M	D	0.070
Wall Type 2	M	L	0.290

Exposure	Net Wall Areas (sqft) Wall Type 1	Wall Type 2	Wall Type 3
NE	0.0	0.0	NA
E	0.0	0.0	NA
SE	0.0	0.0	NA
S	0.0	0.0	NA
SW	128.0	21.0	NA
W	0.0	0.0	NA
NW	192.0	0.0	NA
N	0.0	0.0	NA

****

3. ROOF INFORMATION (Number of Roof Types = 1)

	Weight (lb/sqft)	Ext Color (D,M,L)	U-Value (BTU/hr/sqft/F)	Area (sqft)
Roof 1	L	D	0.030	416.0

****

4. GLASS INFORMATION (Number of Glass Types = 1)

	U-Value (BTU/hr/sqft/F)	Glass Factor	Internal Shades
Glass Type 1	0.690	0.65	Y

<---------------- External Shading Information ---------------->

	Window Height (ft)	Window Width (ft)	Reveal Depth (in)	Overhang Height (in)	Overhang Extension (in)	Fin Separation (in)	Fin Exten. (in)
Shade 1	4.0	4.0	3.0	12.0	60.0	0.0	0.0
Shade 2	8.0	4.0	0.0	0.0	0.0	0.0	0.0
Shade 3	8.0	4.0	0.0	0.0	0.0	0.0	0.0

****

COMPLEX SPACE DESCRIPTION

Space Name : 206 | 03-14-94
Prepared By : E.A.C., P.C. Burke, VA | 6063092204
Carrier Hourly Analysis Program |

4. GLASS INFORMATION (continued)

	Glass Areas (sqft)					
	Type 1		Type 2		Type 3	
Exposure	Area	Shade	Area	Shade	Area	Shade
NE	76.0	1	NA	NA	NA	NA
E	0.0	0	NA	NA	NA	NA
SE	0.0	0	NA	NA	NA	NA
S	0.0	0	NA	NA	NA	NA
SW	0.0	0	NA	NA	NA	NA
W	0.0	0	NA	NA	NA	NA
NW	0.0	0	NA	NA	NA	NA
N	0.0	0	NA	NA	NA	NA
H	0.0	0	NA	NA	NA	NA

5. INTERNAL LOADS

SPACE DATA : Floor Area = 384 sqft Building Wt. = M lb/sqft

PEOPLE : sqft/person = 192.0 Total People = 2
Schedule No. = 3 Activity Level = 1

LIGHTING : W/sqft = 0.83 Total Watts = 320
Schedule No. = 3 Wattage Mult. = 1.25
Fixture Type = 1 Recessed, not vented

OTHER ELECTRIC: W/sqft = 2.11 Total Watts = 810
Schedule No. = 4

MISC. SENSIBLE: Load = 0 BTU/hr Schedule No. = 1
MISC. LATENT : Load = 0 BTU/hr Schedule No. = 1

6. PARTITIONS, INFILTRATION, GROUND

PARTITIONS (Next to Unconditioned Spaces)	Area (sqft)	U-Value (BTU/hr/sqft/F)	Unconditioned Space Temp. Cooling (deg F or %)	Heating (deg F or %)
Walls	0.0	0.100	90.0 F	55.0 F
Ceilings	0.0	0.100	90.0 F	50.0 F
Floors	0.0	0.100	90.0 F	50.0 F

INFILTRATION			GROUND ELEMENT	
Cooling	: 0.10 CFM/sqft =	38 CFM	Area :	0.0 sqft
Heating	: 0.15 CFM/sqft =	58 CFM	Perimeter :	0.0 ft
Typical	: 0.10 CFM/sqft =	38 CFM	Depth :	0.0 ft

Base Building Simulation Data

ENERGY BUDGET <A>

Building : #174 AP HILL-GUEST HOUSE 02-22-94
Site : Fort AP Hill, Virginia 6063092204
Prepared By : E.A.C., P.C. Burke, VA
Carrier Hourly Analysis Program

TABLE 1. ANNUAL LOADS

Component	(kBTU)	(kBTU/sqft)*
Cooling Loads *	93,520	19.483
Heating Loads *	116,238	24.216

TABLE 2. ENERGY BY SYSTEM COMPONENT

Component	Site Energy (kBTU)	Site Energy (kBTU/sqft)*	Source Energy (kBTU)	Source Energy (kBTU/sqft)*
Air System Fans	16,820	3.504	16,820	3.504
Cooling Plants	37,234	7.757	37,234	7.757
Heating Plants	98,527	20.527	98,527	20.527
Pumps	0	0.000	0	0.000
>> HVAC Total	152,581	31.788	152,581	31.788
Lights	66,297	13.812	66,297	13.812
Other Electric	41,588	8.664	41,588	8.664
Misc. Electric	0	0.000	0	0.000
Dom. Hot Water	118,237	24.633	118,237	24.633
>> Non-HVAC Total	226,122	47.109	226,122	47.109
>> GRAND TOTAL	378,703	78.897	378,703	78.897

* Notes:
1. Site energy is the actual energy consumed.
2. Source energy accounts for electrical generating inefficiencies. For this study:
   Electric generating efficiency =100.0 %
3. Energy per unit floor area is based on the gross building floor area. For this building:
   Gross floor area = 4,800 sqft
   Conditioned floor area = 4,549 sqft
4. Annual cooling load is the sum of all cooling plant loads.
5. Annual heating load is the sum of all primary and auxiliary heating plant loads. It does not include the domestic water heating load.

Stand Alone Energy Conservation Opporutnities

The list of ECO's discussed at the interim review meeting were analyzed to determined if any of the ECO's were applicable to the study building. The ECO's listed below are applicable for this study building. Each ECO was simulated as a stand alone ECO so that a ranking could be determined based on the ascending order of SIR's and the simple payback periods. If the SIR's were greater than 1.25 and the simple payback was about 10 years for the stand alone ECO , then the ECO was selected for further study and synergistic effects were then taken into account.

The Following ECO's have been arranged according to their SIR's. ECO's with SIR's greater than 1.25, and a simple payback period of about 10 years, were then selected for further evaluation (Synergistic Effects). The Following ECO's have been arranged according to their SIR's. These ECO's only apply to Building 174

Stand Alone ECO's (No Synergistic Effects)

ECO	Construction Cost	Energy Savings (Mbtu)	$ Savings	Simple Payback	SIR
Low Flow Shower Heads	268	37.2	769	0.3	37.70
Compact Fluor. Lights	446	41.9	774	0.6	20.50
Occupancy Sensors	1,600	55.4	1,021	1.5	7.55
Energy Savings Fluor. Lamps	995	34.6	639	1.5	7.55
Water Heater Controls	85	1.13	23	3.6	3.61
F32 T-8 Lighting System	5,100	42.7	788	6.5	1.83

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Low Flow Shower Heads

LIFE CYCLE COST ANALYSIS SUMMARY
WITH SYNERGISTIC EFFECTS

LOCATION: Fort A.P. Hill, Virginia — REGION: 3 — PROJECT NO.: DACA 31-89-C-0198
PROJECT TITLE: Fort A.P. Hill- Energy Engineering Analysis Program — FISCAL YEAR: 1994
DISCRETE PORTION NAME: Low Flow Shower Heads
ANALYSIS DATE: January 1994 — ECONOMIC LIFE (YRS 20 — PREPARER: JJS

1. INVESTMENT COSTS:

A. CONSTRUCTION COST	$	268	
B. SIOH	$	15	
C. DESIGN COST	$	16	
D. TOTAL COST (1A+1B+1C)	$	299	
E. SALVAGE VALUE OF EXISTING EQUIPMENT			
F. PUBLIC UTILITY COMPANY REBATE			
G. TOTAL INVESTMENT (1D-1E-1F)			$299

2. ENERGY SAVINGS (+)/COST(-):

DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS- Oct 1992

ENERGY SOURCE	COST $/MBTU(1)	SAVING(S) MBTU/YR(2)	ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELEC	$20.67	37.2	$ 769	14.65	$ 11,265
B. DIST	$5.69		$	17.70	$
C. RESID			$		$
D. NG			$		$
E. LPG	$7.76		$	20.60	$
F. COAL			$		$
G. SOLAR			$		$
H. GEOTH			$		$
I. BIOMA			$		$
J. REFUS			$		$
K. WIND			$		$
L. OTHER			$		$
M. DEMAND SAVINGS			$		$
N. TOTAL		37	$ 769		$ 11,265

3. NON ENERGY SAVINGS (+) OR COST (-):

A. ANNUAL RECURRING (+/-)
(1) DISCOUNT FACTOR (TABLE A)
(2) DISCOUNTED SAVINGS/COST (3A X 3A1)

B. NON RECURRING SAVINGS (+) OR COST (-)

ITEM	SAVINGS(+) COST(-)(1)	YEAR OF OCCUR. (2)	DISCOUNT FACTOR(3)	DISCOUNTED SAVINGS(+)COST(-)(4)
a.	$			$
b.	$			$
c.	$			$
d. TOTAL				$

C. TOTAL NON ENERGY DISCOUNTED SAVINGS (3A2+3Bd4)

4. SIMPLE PAYBACK 1G/(2N3+3A+(3Bd1/ECONOMIC LIFE)):	0.39 YEARS
5. TOTAL NET DISCOUNTED SAVINGS (2N5+3C):	$11,265
6. SAVINGS TO INVESTMENT RATION (SIR) 5/1G:	37.70
7. ADJUSTED INTERNAL RATE OF RETURN (AIRR):	20.69%

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375

CONSTRUCTION COST ESTIMATE

PREPARED: March 1994

PROJECT: Energy Savings Oppurtunity Survey

CONTRACT NO.: DACA 31-89-C-0198

LOCATION: Fort A.P. Hill, Virginia

AE PROJECT NO.: 92008

AE: Engineering Applications Consultants, P.C.

ESTIMATOR: JS

CHECKED BY: VP

PRELIM:

FINAL: X

SUMMARY: Low Flow Shower Heads

ITEM	QUANTITY NO.	QUANTITY MEAS	MATERIAL UNIT	MATERIAL COST	LABOR UNIT	LABOR COST	TOTAL COST
Building 174							
Low Flow Shower Heads	6	EA	25.00	150	7.00	42	192
SUB-TOTAL				150		42	192

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CONSTRUCTION COST ESTIMATE

PREPARED: March 1994

PROJECT: Energy Savings Oppurtunity Survey

CONTRACT NO.: DACA 31-89-C-0198

LOCATION: Fort A.P. Hill, Virginia

AE PROJECT NO.:

ESTIMATOR: JS

PRELIM:

AE: Engineering Applications Consultants, P.C.

CHECKED BY: VP

FINAL: X

SUMMARY: Low Flow Shower Heads

ITEM	QUANTITY NO.	QUANTITY MEAS	MATERIAL UNIT	MATERIAL COST	LABOR UNIT	LABOR COST	TOTAL COST
SUBTOTAL PREVIOUS PAGE				150		42	192
MARK-UP ON LABOR SUB-TOTAL	21.0%			—		9	9 201
TAXES ON MATERIAL SUB-TOTAL	5.0%			8		—	8 208
OVERHEAD SUB-TOTAL	15.0%						31 240
PROFIT SUB-TOTAL	12.0%						29 268
PRIME MARK-UP ON SUB SUB-TOTAL							268
GRAND TOTAL							300

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Engineering
Applications
Consultants

A Professional
Corporation

9004-B Crownwood Ct.
Burke, Virginia 22015-1630
(703) 978-0923

ENGINEERING ANALYSIS

Sheet 1 of 1

By: JS

Low Flow Shower Heads - Bldg 174

Project: Fort A. P. Hill ESOS Date: 2-28-94

Contract No.: DACA 31-89-C-0198 EAC Project No.: 92008

ELECTRIC WATER HEATER - 120 gal EFF. = 100 %

1 shower - 6 MIN, EXIST Shower Head FLOW ≈ 5.5 gpm

1 shower per DAY per person, TANK TEMP = 120,

INITIAL WATER TEMP = GROUND WATER TEMP = 55° F

WATER USAGE:

$$6\text{ MIN} \times \frac{5.5\text{ gal}}{\text{MIN}} \times \frac{1\text{ shower}}{\text{DAY}} = 33\text{ gal/day} \times \frac{8.3\text{ lbm}}{\text{gal } H_2O} = \frac{273.9\text{ lbm}}{\text{day}} = \boxed{11.41\text{ lbm/HR}}$$

ENERGY USAGE: $\boxed{Q = \frac{1}{EFF}\dot{m}\, c_p\, \Delta T}$

$$Q = \frac{1}{1.0}\left(\frac{11.41\text{ lbm}}{\text{HR}}\right) \times \frac{.999\text{ Btu}}{\text{lbm }^\circ F} \times (120-55)^\circ F = \frac{756\text{ Btu}}{\text{HR}}$$

$$= \frac{756\text{ Btu}}{\text{HR}} \times \frac{24\text{ HRS}}{\text{DAY}} \times \frac{365\text{ days}}{\text{YR}} \times \frac{1\text{ MBtu}}{10^6\text{ Btu's}} = 6.6\frac{\text{MBtu}}{\text{YR}}$$

LOW FLOW SHOWER HEADS

$$6\text{ MIN} \times \frac{2.5\text{ gal}}{\text{MIN}} \times \frac{1\text{ shower}}{\text{day}} \times \frac{1\text{ day}}{24\text{ HR}} = .625\text{ lbm/HR}$$

$$Q = 41.4\frac{\text{Btu}}{\text{HR}} = .363\text{ MBtu/YR}$$

Savings (PER SHOWER HEAD) = $6.6\frac{\text{MBtu}}{\text{YR}} - .363\frac{\text{MBtu}}{\text{YR}} = 6.24\frac{\text{MBtu}}{\text{YR}}$

Compact Fluorescent Lights

LIFE CYCLE COST ANALYSIS SUMMARY
WITH SYNERGISTIC EFFECTS

LOCATION: Fort A.P. Hill, Virginia — REGION: 3 — PROJECT NO.: DACA 31-89-C-0198
PROJECT TITLE: Fort A.P. Hill- Energy Engineering Analysis Program — FISCAL YEAR: 1994
DISCRETE PORTION NAME: Compact Fluorescent Lights
ANALYSIS DATE: January 1994 — ECONOMIC LIFE (YRS 15 — PREPARER: JJS

1. INVESTMENT COSTS:

A. CONSTRUCTION COST	$ 446	
B. SIOH	$ 25	
C. DESIGN COST	$ 27	
D. TOTAL COST (1A+1B+1C)	$ 497	
E. SALVAGE VALUE OF EXISTING EQUIPMENT		
F. PUBLIC UTILITY COMPANY REBATE		
G. TOTAL INVESTMENT (1D-1E-1F)		$497

2. ENERGY SAVINGS (+)/COST(-):

DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS- Oct 1992

ENERGY SOURCE	COST $/MBTU(1)	SAVING(S) MBTU/YR(2)	ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELEC	$20.67	41.9	$ 866	11.77	$ 10,194
B. DIST	$5.69		$	13.83	$
C. RESID			$		$
D. NG			$		$
E. LPG	$7.76		$	15.34	$
F. COAL			$		$
G. SOLAR			$		$
H. GEOTH			$		$
I. BIOMA			$		$
J. REFUS			$		$
K. WIND			$		$
L. OTHER			$		$
M. DEMAND SAVINGS			$		$
N. TOTAL		42	$ 866		$ 10,194

3. NON ENERGY SAVINGS (+) OR COST (-):

A. ANNUAL RECURRING (+/-)
(1) DISCOUNT FACTOR (TABLE A)
(2) DISCOUNTED SAVINGS/COST (3A X 3A1)

B. NON RECURRING SAVINGS (+) OR COST (-)

ITEM	SAVINGS(+) COST(-)(1)	YEAR OF OCCUR. (2)	DISCOUNT FACTOR(3)	DISCOUNTED SAVINGS(+)COST(-)(4)
a.	$			$
b.	$			$
c.	$			$
d. TOTAL				$

C. TOTAL NON ENERGY DISCOUNTED SAVINGS (3A2+3Bd4)

4. SIMPLE PAYBACK 1G/(2N3+3A+(3Bd1/ECONOMIC LIFE)): 0.57 YEARS
5. TOTAL NET DISCOUNTED SAVINGS (2N5+3C): $10,194
6. SAVINGS TO INVESTMENT RATION (SIR) 5/1G: 20.50
7. ADJUSTED INTERNAL RATE OF RETURN (AIRR): 23.20%

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CONSTRUCTION COST ESTIMATE	PREPARED: March 1994 SHEET 1 OF 2
PROJECT: Energy Savings Oppurtunity Survey LOCATION: Fort A.P. Hill, Virginia AE PROJECT NO.: 92008 AE: Engineering Applications Consultants, P.C.	CONTRACT NO.: DACA 31-89-C-0198 ESTIMATOR: JS PRELIM: CHECKED BY: VP FINAL: X

SUMMARY: Install Compact Fluorescent Lights

ITEM	QUANTITY		MATERIAL		LABOR		TOTAL COST
	NO.	MEAS	UNIT	COST	UNIT	COST	
Building 174							
Replace Incandescent Lighting W/Compact Fl							
18 Watt Quad Fl. (LCFP18)	14	EA	23.00	322	0.50	7	329
SUB-TOTAL				322		7	329

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CONSTRUCTION COST ESTIMATE

PREPARED: March 1994 SHEET 2 OF 2

PROJECT: Energy Savings Oppurtunity Survey

CONTRACT NO.: DACA 31-89-C-0198

LOCATION: Fort A.P. Hill, Virginia
AE PROJECT NO.:
AE: Engineering Applications Consultants, P.C.

ESTIMATOR: JS PRELIM:
CHECKED BY: VP FINAL: X

SUMMARY: Install Compact Fluorescent Lights

ITEM	QUANTITY		MATERIAL		LABOR		TOTAL COST
	NO.	MEAS	UNIT	COST	UNIT	COST	
SUBTOTAL PREVIOUS PAGE				322		7	329
MARK-UP ON LABOR SUB-TOTAL	21.0%			—		1	1 330
TAXES ON MATERIAL SUB-TOTAL	5.0%			16		—	16 347
OVERHEAD SUB-TOTAL	15.0%						52 399
PROFIT SUB-TOTAL	12.0%						48 446
PRIME MARK-UP ON SUB SUB-TOTAL							 446
GRAND TOTAL							400

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ENERGY BUDGET <A>

Building : 174- Compact Fluor. 02-23-94
Site : Fort AP Hill, Virginia 6063092204
Prepared By : E.A.C., P.C. Burke, VA
Carrier Hourly Analysis Program

TABLE 1. ANNUAL LOADS

Component	(kBTU)	(kBTU/sqft)*
Cooling Loads *	85,241	17.759
Heating Loads *	125,783	26.205

TABLE 2. ENERGY BY SYSTEM COMPONENT

Component	Site Energy (kBTU)	Site Energy (kBTU/sqft)*	Source Energy (kBTU)	Source Energy (kBTU/sqft)*
Air System Fans	15,045	3.134	15,352	3.198
Cooling Plants	33,905	7.064	34,597	7.208
Heating Plants	105,813	22.044	107,972	22.494
Pumps	0	0.000	0	0.000
>> HVAC Total	154,764	32.242	157,922	32.900
Lights	54,311	11.315	55,420	11.546
Other Electric	35,735	7.445	36,464	7.597
Misc. Electric	0	0.000	0	0.000
Dom. Hot Water	91,962	19.159	93,839	19.550
>> Non-HVAC Total	182,009	37.918	185,723	38.692
>> GRAND TOTAL	336,772	70.161	343,645	71.593

* Notes:
1. Site energy is the actual energy consumed.
2. Source energy accounts for electrical generating inefficiencies. For this study:
   Electric generating efficiency = 98.0 %
3. Energy per unit floor area is based on the gross building floor area. For this building:
   Gross floor area = 4,800 sqft
   Conditioned floor area = 4,549 sqft
4. Annual cooling load is the sum of all cooling plant loads.
5. Annual heating load is the sum of all primary and auxiliary heating plant loads. It does not include the domestic water heating load.

Occupancy Sensors

LIFE CYCLE COST ANALYSIS SUMMARY
WITH SYNERGISTIC EFFECTS

LOCATION: Fort A.P. Hill, Virginia | REGION: 3 | PROJECT NO.: DACA 31-89-C-0198
PROJECT TITLE: Fort A.P. Hill- Energy Engineering Analysis Program | FISCAL YEAR: 1994
DISCRETE PORTION NAME: Occupancy Sensors
ANALYSIS DATE: January 1994 | ECONOMIC LIFE (YRS 15 | PREPARER: JJS

1. INVESTMENT COSTS:

A. CONSTRUCTION COST	$	1,600	
B. SIOH	$	88	
C. DESIGN COST	$	96	
D. TOTAL COST (1A+1B+1C)	$	1,784	
E. SALVAGE VALUE OF EXISTING EQUIPMENT			
F. PUBLIC UTILITY COMPANY REBATE			
G. TOTAL INVESTMENT (1D-1E-1F)			$1,784

2. ENERGY SAVINGS (+)/COST(-):

DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS- Oct 1992

ENERGY SOURCE	COST $/MBTU(1)	SAVING(S) MBTU/YR(2)	ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELEC	$20.67	55.4	$ 1,145	11.77	$ 13,478
B. DIST	$5.69		$	13.83	$
C. RESID			$		$
D. NG			$		$
E. LPG	$7.76		$	15.34	$
F. COAL			$		$
G. SOLAR			$		$
H. GEOTH			$		$
I. BIOMA			$		$
J. REFUS			$		$
K. WIND			$		$
L. OTHER			$		$
M. DEMAND SAVINGS			$		$
N. TOTAL		55	$ 1,145		$ 13,478

3. NON ENERGY SAVINGS (+) OR COST (-):

A. ANNUAL RECURRING (+/-)
(1) DISCOUNT FACTOR (TABLE A)
(2) DISCOUNTED SAVINGS/COST (3A X 3A1)

B. NON RECURRING SAVINGS (+) OR COST (-)

ITEM	SAVINGS(+) COST(-)(1)	YEAR OF OCCUR. (2)	DISCOUNT FACTOR(3)	DISCOUNTED SAVINGS(+)COST(-)(4)
a.	$			$
b.	$			$
c.	$			$
d. TOTAL				$

C. TOTAL NON ENERGY DISCOUNTED SAVINGS (3A2+3Bd4)

4. SIMPLE PAYBACK 1G/(2N3+3A+(3Bd1/ECONOMIC LIFE)): 1.56 YEARS
5. TOTAL NET DISCOUNTED SAVINGS (2N5+3C): $13,478
6. SAVINGS TO INVESTMENT RATION (SIR) 5/1G: 7.55
7. ADJUSTED INTERNAL RATE OF RETURN (AIRR): 15.01%

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CONSTRUCTION COST ESTIMATE

PREPARED: March 1994 SHEET 1 OF 2

PROJECT: Energy Savings Oppurtunity Survey

CONTRACT NO.: DACA 31-89-C-0198

LOCATION: Fort A.P. Hill, Virginia
AE PROJECT NO.: 92008
AE: Engineering Applications Consultants, P.C.

ESTIMATOR: JS PRELIM:
CHECKED BY: VP FINAL: X

SUMMARY: Occupancy Sensors

ITEM	QUANTITY		MATERIAL		LABOR		TOTAL COST
	NO.	MEAS	UNIT	COST	UNIT	COST	
Building 174							
Occupancy Sensors-Infrared Wall Switch	14	EA	77.00	1,078	7.00	98	1,176
SUB-TOTAL				1,078		98	1,176

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CONSTRUCTION COST ESTIMATE	PREPARED: March 1994	SHEET OF
PROJECT: Energy Savings Oppurtunity Survey		SHEET 2 OF 2
	CONTRACT NO.: DACA 31-89-C-0198	
LOCATION: Fort A.P. Hill, Virginia		
AE PROJECT NO.:	ESTIMATOR: JS	PRELIM:
AE: Engineering Applications Consultants, P.C.	CHECKED BY: VP	FINAL: X

SUMMARY: Occupancy Sensors

ITEM	QUANTITY		MATERIAL		LABOR		TOTAL COST
	NO.	MEAS	UNIT	COST	UNIT	COST	
SUBTOTAL PREVIOUS PAGE				1,078		98	1,176
MARK-UP ON LABOR	21.0%			—		21	21
SUB-TOTAL							1,197
TAXES ON MATERIAL	5.0%			54		—	54
SUB-TOTAL							1,250
OVERHEAD	15.0%						188
SUB-TOTAL							1,438
PROFIT	12.0%						173
SUB-TOTAL							1,611
PRIME MARK-UP ON SUB							
SUB-TOTAL							1,611
GRAND TOTAL							1,600

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ENERGY BUDGET <A>

Building : 174- Occupancy Sensors — 02-23-94
Site : Fort AP Hill, Virginia — 6063092204
Prepared By : E.A.C., P.C. Burke, VA
Carrier Hourly Analysis Program —

TABLE 1. ANNUAL LOADS

Component	(kBTU)	(kBTU/sqft)*
Cooling Loads *	74,169	15.452
Heating Loads *	137,992	28.748

TABLE 2. ENERGY BY SYSTEM COMPONENT

Component	Site Energy (kBTU)	Site Energy (kBTU/sqft)*	Source Energy (kBTU)	Source Energy (kBTU/sqft)*
Air System Fans	15,490	3.227	15,806	3.293
Cooling Plants	29,753	6.199	30,360	6.325
Heating Plants	119,456	24.887	121,894	25.395
Pumps	0	0.000	0	0.000
>> HVAC Total	164,699	34.312	168,060	35.013
Lights	47,458	9.887	48,426	10.089
Other Electric	19,272	4.015	19,666	4.097
Misc. Electric	0	0.000	0	0.000
Dom. Hot Water	91,962	19.159	93,839	19.550
>> Non-HVAC Total	158,692	33.061	161,931	33.736
>> GRAND TOTAL	323,391	67.373	329,991	68.748

* Notes:
1. Site energy is the actual energy consumed.
2. Source energy accounts for electrical generating inefficiencies. For this study:
   Electric generating efficiency = 98.0 %
3. Energy per unit floor area is based on the gross building floor area. For this building:
   Gross floor area = 4,800 sqft
   Conditioned floor area = 4,549 sqft
4. Annual cooling load is the sum of all cooling plant loads.
5. Annual heating load is the sum of all primary and auxiliary heating plant loads. It does not include the domestic water heating load.

Energy Savings Fluorescent Lamps

LIFE CYCLE COST ANALYSIS SUMMARY
WITH SYNERGISTIC EFFECTS

LOCATION: Fort A.P. Hill, Virginia REGION: 3 PROJECT NO.: DACA 31-89-C-0198
PROJECT TITLE: Fort A.P. Hill- Energy Engineering Analysis Program FISCAL YEAR: 1994
DISCRETE PORTION NAME: Energy Savings Fluorescent Lamps
ANALYSIS DATE: January 1994 ECONOMIC LIFE (YRS 15 PREPARER: JJS

1. INVESTMENT COSTS:

A. CONSTRUCTION COST	$	995	
B. SIOH	$	55	
C. DESIGN COST	$	60	
D. TOTAL COST (1A+1B+1C)	$	1,109	
E. SALVAGE VALUE OF EXISTING EQUIPMENT			
F. PUBLIC UTILITY COMPANY REBATE			
G. TOTAL INVESTMENT (1D-1E-1F)			$1,109

2. ENERGY SAVINGS (+)/COST(-):

DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS- Oct 1992

ENERGY SOURCE	COST $/MBTU(1)	SAVING(S) MBTU/YR(2)	ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELEC	$20.67	19.6	$ 405	11.77	$ 4,768
B. DIST	$5.69		$	13.83	$
C. RESID			$		$
D. NG			$		$
E. LPG	$7.76		$	15.34	$
F. COAL			$		$
G. SOLAR			$		$
H. GEOTH			$		$
I. BIOMA			$		$
J. REFUS			$		$
K. WIND			$		$
L. OTHER			$		$
M. DEMAND SAVINGS			$		$
N. TOTAL		20	$ 405		$ 4,768

3. NON ENERGY SAVINGS (+) OR COST (-):

A. ANNUAL RECURRING (+/-)
(1) DISCOUNT FACTOR (TABLE A)
(2) DISCOUNTED SAVINGS/COST (3A X 3A1)

B. NON RECURRING SAVINGS (+) OR COST (-)

ITEM	SAVINGS(+) COST(-)(1)	YEAR OF OCCUR. (2)	DISCOUNT FACTOR(3)	DISCOUNTED SAVINGS(+)COST(-)(4)
a.	$			$
b.	$			$
c.	$			$
d. TOTAL				$

C. TOTAL NON ENERGY DISCOUNTED SAVINGS (3A2+3Bd4)

4. SIMPLE PAYBACK 1G/(2N3+3A+(3Bd1/ECONOMIC LIFE)):	2.74 YEARS
5. TOTAL NET DISCOUNTED SAVINGS (2N5+3C):	$4,768
6. SAVINGS TO INVESTMENT RATION (SIR) 5/1G:	4.30
7. ADJUSTED INTERNAL RATE OF RETURN (AIRR):	10.62%

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CONSTRUCTION COST ESTIMATE	PREPARED: March 1994	SHEET 1 OF 2
PROJECT: Energy Savings Oppurtunity Survey	CONTRACT NO.: DACA 31-89-C-0198	
LOCATION: Fort A.P. Hill, Virginia		
AE PROJECT NO.: 92008	ESTIMATOR: JS	PRELIM:
AE: Engineering Applications Consultants, P.C.	CHECKED BY: VP	FINAL: X

SUMMARY: Energy Saving Fluor. Lamps

ITEM	QUANTITY		MATERIAL		LABOR		TOTAL COST
	NO.	MEAS	UNIT	COST	UNIT	COST	
Building 174 Install 35 Watt Energy Saving Fluor. Lamps	142	EA	3.45	490	1.50	213	703
SUB-TOTAL				490		213	703

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CONSTRUCTION COST ESTIMATE	PREPARED: March 1994	SHEET 2 OF 2
PROJECT: Energy Savings Oppurtunity Survey	CONTRACT NO.: DACA 31-89-C-0198	
LOCATION: Fort A.P. Hill, Virginia		
AE PROJECT NO.:	ESTIMATOR: JS	PRELIM:
AE: Engineering Applications Consultants, P.C.	CHECKED BY: VP	FINAL: X

SUMMARY: Energy Saving Fluor. Lamps

ITEM	QUANTITY NO.	QUANTITY MEAS	MATERIAL UNIT	MATERIAL COST	LABOR UNIT	LABOR COST	TOTAL COST
SUBTOTAL PREVIOUS PAGE				490		213	703
MARK-UP ON LABOR	21.0%			—		45	45
SUB-TOTAL							748
TAXES ON MATERIAL	5.0%			25		—	25
SUB-TOTAL							772
OVERHEAD	15.0%						116
SUB-TOTAL							888
PROFIT	12.0%						107
SUB-TOTAL							995
PRIME MARK-UP ON SUB							
SUB-TOTAL							995
GRAND TOTAL							1,000

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ENERGY BUDGET <A>

Building : 174-34W Lamps w/Synerg. — 02-23-94
Site : Fort AP Hill, Virginia — 6063092204
Prepared By : E.A.C., P.C. Burke, VA
Carrier Hourly Analysis Program

TABLE 1. ANNUAL LOADS

Component	(kBTU)	(kBTU/sqft)*
Cooling Loads *	70,974	14.786
Heating Loads *	141,987	29.581

TABLE 2. ENERGY BY SYSTEM COMPONENT

	<----- Site Energy ----->		<---- Source Energy ---->	
Component	(kBTU)	(kBTU/sqft)*	(kBTU)	(kBTU/sqft)*
Air System Fans	14,700	3.062	15,000	3.125
Cooling Plants	28,441	5.925	29,022	6.046
Heating Plants	122,433	25.507	124,932	26.027
Pumps	0	0.000	0	0.000
>> HVAC Total	165,574	34.495	168,953	35.199
Lights	40,379	8.412	41,203	8.584
Other Electric	19,272	4.015	19,666	4.097
Misc. Electric	0	0.000	0	0.000
Dom. Hot Water	91,962	19.159	93,839	19.550
>> Non-HVAC Total	151,614	31.586	154,708	32.231
>> GRAND TOTAL	317,188	66.081	323,661	67.429

* Notes:
1. Site energy is the actual energy consumed.
2. Source energy accounts for electrical generating inefficiencies. For this study:
   Electric generating efficiency = 98.0 %
3. Energy per unit floor area is based on the gross building floor area. For this building:
   Gross floor area = 4,800 sqft
   Conditioned floor area = 4,549 sqft
4. Annual cooling load is the sum of all cooling plant loads.
5. Annual heating load is the sum of all primary and auxiliary heating plant loads. It does not include the domestic water heating load.

Shut Down Energy to Hotwater Heaters or Modify Controls

LIFE CYCLE COST ANALYSIS SUMMARY
WITH SYNERGISTIC EFFECTS

LOCATION: Fort A.P. Hill, Virginia REGION: 3 PROJECT NO.: DACA 31-89-C-0198
PROJECT TITLE: Fort A.P. Hill- Energy Engineering Analysis Program FISCAL YEAR: 1994
DISCRETE PORTION NAME: Shut Down Energy to Hotwater Heaters or Modify Controls
ANALYSIS DATE: January 1994 ECONOMIC LIFE (YRS 20 PREPARER: JJS

1. INVESTMENT COSTS:

A. CONSTRUCTION COST	$	85	
B. SIOH	$	5	
C. DESIGN COST	$	5	
D. TOTAL COST (1A+1B+1C)	$	95	
E. SALVAGE VALUE OF EXISTING EQUIPMENT			
F. PUBLIC UTILITY COMPANY REBATE			
G. TOTAL INVESTMENT (1D-1E-1F)			$95

2. ENERGY SAVINGS (+)/COST(-):

DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS- Oct 1992

ENERGY SOURCE	COST $/MBTU(1)	SAVING(S) MBTU/YR(2)	ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELEC	$20.67	1.1	$ 23	14.65	$ 342
B. DIST	$5.69		$	17.70	$
C. RESID			$		$
D. NG			$		$
E. LPG	$7.76		$	20.60	$
F. COAL			$		$
G. SOLAR			$		$
H. GEOTH			$		$
I. BIOMA			$		$
J. REFUS			$		$
K. WIND			$		$
L. OTHER			$		$
M. DEMAND SAVINGS			$		$
N. TOTAL		1	$ 23		$ 342

3. NON ENERGY SAVINGS (+) OR COST (-):

A. ANNUAL RECURRING (+/-)
(1) DISCOUNT FACTOR (TABLE A)
(2) DISCOUNTED SAVINGS/COST (3A X 3A1)

B. NON RECURRING SAVINGS (+) OR COST (-)

ITEM	SAVINGS(+) COST(-)(1)	YEAR OF OCCUR. (2)	DISCOUNT FACTOR(3)	DISCOUNTED SAVINGS(+)COST(-)(4)
a.	$			$
b.	$			$
c.	$			$
d. TOTAL				$

C. TOTAL NON ENERGY DISCOUNTED SAVINGS (3A2+3Bd4)

4. SIMPLE PAYBACK 1G/(2N3+3A+(3Bd1/ECONOMIC LIFE)):	4.06 YEARS
5. TOTAL NET DISCOUNTED SAVINGS (2N5+3C):	$342
6. SAVINGS TO INVESTMENT RATION (SIR) 5/1G:	3.61
7. ADJUSTED INTERNAL RATE OF RETURN (AIRR):	6.89%

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CONSTRUCTION COST ESTIMATE

PROJECT: Energy Savings Oppurtunity Survey	PREPARED: March 1994 SHEET 1 OF 2
LOCATION: Fort A.P. Hill, Virginia	CONTRACT NO.: DACA 31-89-C-0198
AE PROJECT NO.: 92008	ESTIMATOR: JS PRELIM:
AE: Engineering Applications Consultants, P.C.	CHECKED BY: VP FINAL: X

SUMMARY: Shut Down Energy to Hotwater Heaters or Modify Controls

ITEM	QUANTITY		MATERIAL		LABOR		TOTAL COST
	NO.	MEAS	UNIT	COST	UNIT	COST	
Building 174							
Water Heater Timer	1	EA	40.00	40	18.25	18	58
SUB-TOTAL				40		18	58

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CONSTRUCTION COST ESTIMATE	PREPARED: March 1994 SHEET 2 OF 2
PROJECT: Energy Savings Oppurtunity Survey	CONTRACT NO.: DACA 31-89-C-0198
LOCATION: Fort A.P. Hill, Virginia AE PROJECT NO.: AE: Engineering Applications Consultants, P.C.	ESTIMATOR: JS PRELIM: CHECKED BY: VP FINAL: X

SUMMARY: Shut Down Energy to Hotwater Heaters or Modify Controls

ITEM	QUANTITY		MATERIAL		LABOR		TOTAL COST
	NO.	MEAS	UNIT	COST	UNIT	COST	
SUBTOTAL PREVIOUS PAGE				40		18	58
MARK-UP ON LABOR	21.0%			—		4	4
SUB-TOTAL							62
TAXES ON MATERIAL	5.0%			2		—	2
SUB-TOTAL							64
OVERHEAD	15.0%						10
SUB-TOTAL							73
PROFIT	12.0%						9
SUB-TOTAL							82
PRIME MARK-UP ON SUB							
SUB-TOTAL							82
GRAND TOTAL							100

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Water Heater Controls- Install Timer to turn heater off during unoccupied periods

Heater Eff.=	100%	
Tank Capacity	120	Gallons
Utank=	0.22	Btu/F*Ft**2*Hr
Atank=	88.8	Ft**2
Ttank=	120	F
Tsurroundings=	65	F

Hour	Tank Temp F	Heat Lost per Hour (Btu's/Hr)	Total Heat Lost (Btu's)
0	120.0	1,074.5	
			1,050.3
1	117.5	1,026.1	
			1,003.0
2	115.2	979.9	
			957.8
3	112.9	935.7	
			914.6
4	110.7	893.6	
			873.4
5	108.7	853.3	
			834.1
6	106.7	814.9	
			796.5
7	104.8	778.2	
			760.6
8	103.0	743.1	
			726.4
9	101.3	709.6	
			693.7
10	99.7	677.7	
			662.4
11	98.1	647.1	
			632.6
12	96.6	618.0	
Total Heat Lost (Btu's Required to Return Water to 120F) =			(9,905.4)

Total Energy Required to Maintain 120F throughout 12 hour period=	12,893.8	Btu's
Total Energy Required to Return Water to 120F=	(9,905.4)	Btu's
Total Energy Saved per Day (Btu's)=	2,988.4	Btu's/Day
Total Energy Saved per Year=	1.091	MBtu's/Yr

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A Professional
Corporation

9004-B Crownwood Ct.
Burke, Virginia 22015-1630
(703) 978-0923

ENGINEERING ANALYSIS

Sheet 1 of 1

By: JS

WATER HEATERS

Project: Fort A. P. Hill ESOS

Date: 2-28-94

Contract No.: DACA 31-89-C-0198

EAC Project No.: 92008

	R
STEEL JACKET -	.003
1" FOAM INSULATION -	4.4
STEEL TANK -	.003
GLASS LINER -	.14

$$R_{TOT} = 4.546 \frac{hr \cdot °F \cdot Ft^2}{BTU}$$

$$U_{TOT} = \frac{.22 \text{ BTU}}{hr \cdot °F \cdot Ft^2}$$

Replace Exiting Fluorescent Fixtures with Energy Effiecient Fixtures, Ballast and Lamps

LIFE CYCLE COST ANALYSIS SUMMARY
WITH SYNERGISTIC EFFECTS

LOCATION: Fort A.P. Hill, Virginia REGION: 3 PROJECT NO.: DACA 31-89-C-0198
PROJECT TITLE: Fort A.P. Hill- Energy Engineering Analysis Program FISCAL YEAR: 1994
DISCRETE PORTION NAME: Replace Existing Fluorescent Fixtures with Energy Efficient Fixtures, Ballast, and Lamps
ANALYSIS DATE: January 1994 ECONOMIC LIFE (YRS 15 PREPARER: JJS

1. INVESTMENT COSTS:

A. CONSTRUCTION COST	$	5,100	
B. SIOH	$	281	
C. DESIGN COST	$	306	
D. TOTAL COST (1A+1B+1C)	$	5,687	
E. SALVAGE VALUE OF EXISTING EQUIPMENT			
F. PUBLIC UTILITY COMPANY REBATE			
G. TOTAL INVESTMENT (1D-1E-1F)			$5,687

2. ENERGY SAVINGS (+)/COST(-):

DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS- Oct 1992

ENERGY SOURCE	COST $/MBTU(1)	SAVING(S) MBTU/YR(2)		ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)		DISCOUNTED SAVINGS(5)
A. ELEC	$20.67	12.0	$	248	11.77	$	2,919
B. DIST	$5.69		$		13.83	$	
C. RESID			$			$	
D. NG			$			$	
E. LPG	$7.76		$		15.34	$	
F. COAL			$			$	
G. SOLAR			$			$	
H. GEOTH			$			$	
I. BIOMA			$			$	
J. REFUS			$			$	
K. WIND			$			$	
L. OTHER			$			$	
M. DEMAND SAVINGS			$			$	
N. TOTAL		12	$	248		$	2,919

3. NON ENERGY SAVINGS (+) OR COST (-):

A. ANNUAL RECURRING (+/-)
(1) DISCOUNT FACTOR (TABLE A)
(2) DISCOUNTED SAVINGS/COST (3A X 3A1)

B. NON RECURRING SAVINGS (+) OR COST (-)

ITEM		SAVINGS(+) COST(-)(1)	YEAR OF OCCUR. (2)	DISCOUNT FACTOR(3)		DISCOUNTED SAV-INGS(+)COST(-)(4)
a.	$				$	
b.	$				$	
c.	$				$	
d. TOTAL					$	

C. TOTAL NON ENERGY DISCOUNTED SAVINGS (3A2+3Bd4)

4. SIMPLE PAYBACK 1G/(2N3+3A+(3Bd1/ECONOMIC LIFE)):	22.93 YEARS
5. TOTAL NET DISCOUNTED SAVINGS (2N5+3C):	$2,919
6. SAVINGS TO INVESTMENT RATION (SIR) 5/1G:	0.51
7. ADJUSTED INTERNAL RATE OF RETURN (AIRR):	-4.52%

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CONSTRUCTION COST ESTIMATE	PREPARED: March 1994	SHEET 1 OF 2
PROJECT: Energy Savings Oppurtunity Survey	CONTRACT NO.: DACA 31-89-C-0198	
LOCATION: Fort A.P. Hill, Virginia		
AE PROJECT NO.: 92008	ESTIMATOR: JS	PRELIM:
AE: Engineering Applications Consultants, P.C.	CHECKED BY: VP	FINAL: X

SUMMARY: Replace Existing Fluorescent Fixtures with Energy Efficient Fixtures, Ballast, and Lamps

ITEM	QUANTITY NO.	QUANTITY MEAS	MATERIAL UNIT	MATERIAL COST	LABOR UNIT	LABOR COST	TOTAL COST
Building 174							
F32T-8 Lighting Retrofit							
Four Lamp Fixtures Ballast-	66	EA	32.00	2,112	8.00	528	2,640
F32T-8 Lamps	132	EA	6.00	792	1.50	198	990
SUB-TOTAL				2,904		726	3,630

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CONSTRUCTION COST ESTIMATE

PREPARED: March 1994 SHEET OF

SHEET 2 OF 2

PROJECT: Energy Savings Oppurtunity Survey

CONTRACT NO.: DACA 31-89-C-0198

LOCATION: Fort A.P. Hill, Virginia

AE PROJECT NO.:

ESTIMATOR: JS PRELIM:

AE: Engineering Applications Consultants, P.C.

CHECKED BY: VP FINAL: X

SUMMARY: Replace Existing Fluorescent Fixtures with Energy Efficient Fixtures, Ballast, and Lamps

ITEM	QUANTITY		MATERIAL		LABOR		TOTAL COST
	NO.	MEAS	UNIT	COST	UNIT	COST	
SUBTOTAL PREVIOUS PAGE				2,904		726	3,630
MARK-UP ON LABOR SUB-TOTAL	21.0%			—		152	152 3,782
TAXES ON MATERIAL SUB-TOTAL	5.0%			145		—	145 3,928
OVERHEAD SUB-TOTAL	15.0%						589 4,517
PROFIT SUB-TOTAL	12.0%						542 5,059
PRIME MARK-UP ON SUB SUB-TOTAL							5,059
GRAND TOTAL							5,100

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2092

ENERGY BUDGET <A>

Building : 174-T-8 Lightingw/Syn 02-23-94
Site : Fort AP Hill, Virginia 6063092204
Prepared By : E.A.C., P.C. Burke, VA
Carrier Hourly Analysis Program

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TABLE 1. ANNUAL LOADS

Component	(kBTU)	(kBTU/sqft)*
Cooling Loads *	68,309	14.231
Heating Loads *	145,938	30.404

****

TABLE 2. ENERGY BY SYSTEM COMPONENT

Component	Site Energy (kBTU)	Site Energy (kBTU/sqft)*	Source Energy (kBTU)	Source Energy (kBTU/sqft)*
Air System Fans	13,971	2.911	14,257	2.970
Cooling Plants	27,349	5.698	27,908	5.814
Heating Plants	125,354	26.115	127,912	26.648
Pumps	0	0.000	0	0.000
>> HVAC Total	166,674	34.724	170,076	35.432
Lights	33,490	6.977	34,173	7.119
Other Electric	19,272	4.015	19,666	4.097
Misc. Electric	0	0.000	0	0.000
Dom. Hot Water	91,962	19.159	93,839	19.550
>> Non-HVAC Total	144,725	30.151	147,678	30.766
>> GRAND TOTAL	311,399	64.875	317,754	66.199

* Notes:
1. Site energy is the actual energy consumed.
2. Source energy accounts for electrical generating inefficiencies. For this study:
   Electric generating efficiency = 98.0 %
3. Energy per unit floor area is based on the gross building floor area. For this building:
   Gross floor area = 4,800 sqft
   Conditioned floor area = 4,549 sqft
4. Annual cooling load is the sum of all cooling plant loads.
5. Annual heating load is the sum of all primary and auxiliary heating plant loads. It does not include the domestic water heating load.

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Building 1253- Computer Simulation Input Data

BUILDING DESCRIPTION

Building : #1253 - FORT A.P. HILL 03-14-94
Prepared By: E.A.C., P.C. Burke, VA 6063092204
Carrier Hourly Analysis Program

****

1. BUILDING INPUTS

BUILDING NAME = #1253 - FORT A.P. HILL

MISCELLANEOUS ELECTRIC
- Maximum power = 0.0 kW
- Power schedule = 1

DOMESTIC WATER HEATING
- Is a domestic how water system used ? Y
- Maximum hourly hot water use = 10.0 gal
- Hot water schedule = 3
- Average entering water temperature = 50.0 F
- Average hot water supply temperature = 120.0 F
- Heating plant type = 1 : Electric

OTHER INPUTS
- Additional building floor area = 1340.0 sqft
- Electrical generating efficiency = 100.00 %

****

2. PLANT SELECTION

Plant Name	Mult	Plant Name	Mult
Unit #1	1	Unit #2	1

****

3. FUEL & ELECTRIC RATE SELECTION

Fuel or Energy	No.	Name of Rate Schedule	Currency
Electric	1	RAPPAHANNOCK	$
Natural Gas	1	LPG	$
Fuel Oil	1	LPG	$
Propane	1	LPG	$
Remote Source Heating	1	LPG	$
Remote Source Cooling	1	LPG	$

****

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EAC STANDARD FORM
August 1985

Contract No. DACA-31-89-C-0198

HEAT GAIN AND LOSS CALCULATIONS

Preliminary Selection
Final Selection

Project Name: FORT A.P HILL ESOS

EAC Project Number: 92008 Date MARCH 94 By: JS

Location: FORT A P HILL

North Altitude 38.1 Design Month ______

Building Construction:

☒ Light
☐ Medium
☐ Heavy

Thermal Load Averaging Hours ______

Design Conditions

	Summer		Winter
Outside:	DB 93 F	WB 76 F	DB 14 F
Inside:	DB 78 F	WB 60 F	DB 70 F

U-Factors (h-sq ft-F/Btu)

Roof 0.30
Floor .0816
Wall .071
Partition .546 Door .68
Glass (Shading) ______
Glass (No Shading) .68
Shading Coefficient
For Glass ______ (Shading) ______ (No Shading)

Lighting Level ______

Occupancy ______

General Remarks ELEV - 164

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EAC STANDARD FORM
July 1985

SHEET NO. ______

U-VALUE CALCULATION FORM

FOR ROOF/FLOOR

Project: ESOS FORT AP HILL

EAC Project Number: 92008 Date: 12-28-92 By: JS

☐ Roof ☐ Floor

	Material	Resistance (h-sq. ft.-F/Btu) Summer	Winter
1.	Top Surface (Moving Air)	0.25	0.17
2.	Bottom Surface (Still Air)	1.22	
3.	METAL ROOF	.61	
4.	4" BATT	11	
5.	6" BATT (ON DROP CEILING)	19	
6.	DROP CEILING (1/2" THICK)	1.25	
7.			
8.			
	Total (R) =	33.33	
	U = 1/R =	.030	

(Btu/h-sq.ft. - F)

MATERIAL	DIRECTION OF HEAT FLOW	R*
Air Space 3/4" (0 F)	UP	0.93
Air Space 4"	UP	1.03
Air Space 3/4" (90 F)	DN	0.85
Air Space 4"	DN	1.00
Still Air	UP	0.61
Still Air	DN	0.92
Moving Air 7 1/2 MPH	ANY	0.25
Moving Air 15 MPH	ANY	0.17
Acoustical Tile 1/2"		1.25
Acoustical Tile 3/4"		1.89
Sand Plaster 3/8"		0.08
Gypsum Plaster 1/2"		0.45

MATERIAL	R*
Batt/Blanket	
2-2 3/4 in.	7.00
3-4in.	11.00
3.5 in.	13.00
5.5-6.5 in.	19.00
6-7.5 in.	22.00
9-10 in.	30.00
12-13 in.	38.00
Rigid Insul. 1"	2.78
Stryofoam 1"	4.00
Built-up Roof 3/8"	0.33
Asphalt Shingles	0.44

*(h-sq.ft. - F/Btu)

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EAC STANDARD FORM
July 1985

SHEET NO. ______

U-VALUE CALCULATION FORM

FOR WALL/PARTITION

Project: ESDS-FORT AP HILL

EAC Project Number: 92008 Date: 12-28-92 By: JS

☒ Wall ☐ Partition

	Material	Resistance (h-ft^2 - F/Btu) Summer	Winter
1.	Outside Air	0.25	0.17
2.	Inside Still Air	0.68	0.68
3.	METAL SIDING	.61	
4.	BATT INSULATION	11	
5.	1/2" GYP BOARD	.45	
6.			
7.			
8.			
	Total (R) =	12.99	
	U = 1/R =	.077	

(Btu/h-sq.ft. - F)

MATERIAL	R*	MATERIAL	R*
Air Space 3/4" (90 F)	0.84	Blanket/Batt Insul.	
Air Space 3/4" (0 F)	1.18	2-2 3/4 in.	7.00
Still Air	0.68	3-4 in.	11.00
Moving Air 7 1/2 MPH	0.25	3.5 in	13.00
Moving Air 15 MPH	0.17	5.5-6.5 in.	19.00
Face Brick 4"	0.44	6-7.5 in.	22.00
Cinderblock 4"	1.11	9-10 in.	30.00
Cinderblock 8"	1.72	12-13 in.	38.00
Cinderblock 12"	1.89	Rigid Insul. 1"	2.78
Gypsum Bd 3/8"	0.32	Stryofoam 1"	4.00
Gypsum Bd 1/2"	0.45	Vermiculite 1"	2.27
Gypsum Plaster 1/2"	0.45	Vapor Barr.-felt	0.06
Sand Plaster 3/8"	0.08	Fir, Pine & Simil.	
Loose Fill Sandust 1"	2.22	Woods 3/4"	0.94
Perlite Expanded 1"	2.90		

*(h-sq.ft. - F/Btu)

Engineering
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EAC STANDARD FORM
July 1985

SHEET NO. ______

U-VALUE CALCULATION FORM

FOR WALL/PARTITION

Project: ESOS FORT AP HILL

EAC Project Number: 92008 Date: 12-28-92 By: JS

☐ Wall ☑ Partition

	Material	Resistance (h-ft^2 - F/Btu) Summer	Winter
1.	Outside Air	0.25	0.17
2.	Inside Still Air	0.68	0.68
3.	1/2" Gyp Board	.90	
4.			
5.			
6.			
7.			
8.			
	Total (R) =	1.83	
	U = 1/R =	.546	

(Btu/h-sq.ft. - F)

MATERIAL	R*	MATERIAL	R*
Air Space 3/4" (90 F)	0.84	Blanket/Batt Insul.	
Air Space 3/4" (0 F)	1.18	2-2 3/4 in.	7.00
Still Air	0.68	3-4 in.	11.00
Moving Air 7 1/2 MPH	0.25	3.5 in	13.00
Moving Air 15 MPH	0.17	5.5-6.5 in.	19.00
Face Brick 4"	0.44	6-7.5 in.	22.00
Cinderblock 4"	1.11	9-10 in.	30.00
Cinderblock 8"	1.72	12-13 in.	38.00
Cinderblock 12"	1.89	Rigid Insul. 1"	2.78
Gypsum Bd 3/8"	0.32	Stryofoam 1"	4.00
Gypsum Bd 1/2"	0.45	Vermiculite 1"	2.27
Gypsum Plaster 1/2"	0.45	Vapor Barr.-felt	0.06
Sand Plaster 3/8"	0.08	Fir, Pine & Simil.	
Loose Fill Sandust 1"	2.22	Woods 3/4"	0.94
Perlite Expanded 1"	2.90		

*(h-sq.ft. - F/Btu)

MASTER SCHEDULE SUMMARY

Prepared By : E.A.C., P.C. Burke, VA

Carrier Hourly Analysis Program

03-21-94
6063092204

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MASTER SCHEDULE 1. Occupancy Hourly Percentages

Hour ----->	0	1	2	3	4	5	6	7	8	9	10	11
Weekday	0	0	0	0	0	0	25	75	100	100	100	100
Saturday	0	0	0	0	0	0	0	0	50	50	50	50
Sunday	0	0	0	0	0	0	0	0	25	25	25	25
DESIGN	0	0	0	0	0	0	25	100	100	100	100	100

Hour ----->	12	13	14	15	16	17	18	19	20	21	22	23
Weekday	100	100	100	100	75	75	50	50	25	25	25	0
Saturday	50	50	50	50	50	50	0	0	0	0	0	0
Sunday	25	25	25	25	25	25	0	0	0	0	0	0
DESIGN	100	100	100	100	75	75	50	50	50	50	50	0

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MASTER SCHEDULE 2. Lighting Hourly Percentages

Hour ----->	0	1	2	3	4	5	6	7	8	9	10	11
Weekday	5	5	5	5	5	5	50	75	100	100	100	100
Saturday	5	5	5	5	5	5	5	5	50	50	50	50
Sunday	5	5	5	5	5	5	5	5	50	50	50	50
DESIGN	5	5	5	5	5	5	25	75	100	100	100	100

Hour ----->	12	13	14	15	16	17	18	19	20	21	22	23
Weekday	100	100	100	100	100	100	100	50	50	5	5	5
Saturday	50	50	50	50	50	50	5	5	5	5	5	5
Sunday	50	50	50	50	50	50	5	5	5	5	5	5
DESIGN	100	100	100	100	100	100	100	50	50	5	5	5

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MASTER SCHEDULE 3. Water Heater Hourly Percentages

Hour ----->	0	1	2	3	4	5	6	7	8	9	10	11
Weekday	0	0	0	0	0	0	25	50	50	50	50	50
Saturday	0	0	0	0	0	0	0	0	40	40	40	40
Sunday	0	0	0	0	0	0	0	0	25	25	25	25
DESIGN	0	0	0	0	0	0	25	100	100	100	100	100

Hour ----->	12	13	14	15	16	17	18	19	20	21	22	23
Weekday	50	50	50	50	25	25	25	25	25	25	25	0
Saturday	40	40	40	40	40	40	0	0	0	0	0	0
Sunday	25	25	25	25	25	25	0	0	0	0	0	0
DESIGN	100	100	100	100	75	75	50	50	50	50	50	0

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405

Prepared By : E.A.C., P.C. Burke, VA 03-21-94
Carrier Hourly Analysis Program 6063092204

MASTER SCHEDULE 4. Dimmm Lights Hourly Percentages

Hour ----->	0	1	2	3	4	5	6	7	8	9	10	11
Weekday	5	5	5	5	5	5	50	75	100	100	90	80
Saturday	5	5	5	5	5	5	5	5	50	50	25	25
Sunday	5	5	5	5	5	5	5	5	50	50	25	25
DESIGN	5	5	5	5	5	5	25	75	100	100	90	80

Hour ----->	12	13	14	15	16	17	18	19	20	21	22	23
Weekday	60	50	50	40	40	60	80	50	50	5	5	5
Saturday	25	25	25	25	25	25	5	5	5	5	5	5
Sunday.	25	25	25	25	25	25	5	5	5	5	5	5
DESIGN	60	50	50	45	40	60	80	50	50	5	5	5

MASTER SCHEDULE 5. Occupancy Sensors Hourly Percentages

Hour ----->	0	1	2	3	4	5	6	7	8	9	10	11
Weekday	0	0	0	0	0	0	50	75	95	100	100	98
Saturday	0	0	0	0	0	0	0	0	48	48	48	48
Sunday	0	0	0	0	0	0	0	0	48	48	48	48
DESIGN	0	0	0	0	0	0	25	75	95	100	100	96

Hour ----->	12	13	14	15	16	17	18	19	20	21	22	23
Weekday	5	98	98	98	98	98	98	48	48	0	0	0
Saturday	5	48	48	48	48	48	5	0	0	0	0	0
Sunday	5	48	48	48	48	48	5	0	0	0	0	0
DESIGN	5	96	96	96	96	96	96	0	0	0	0	0

MASTER SCHEDULE 6. Bathrm Occ. Sensors Hourly Percentages

Hour ----->	0	1	2	3	4	5	6	7	8	9	10	11
Weekday	0	0	0	0	0	0	2	5	5	5	5	5
Saturday	0	0	0	0	0	0	0	0	2	2	2	2
Sunday	0	0	0	0	0	0	0	0	2	2	2	2
DESIGN	0	0	0	0	0	0	2	2	2	2	2	2

Hour ----->	12	13	14	15	16	17	18	19	20	21	22	23
Weekday	5	5	5	5	5	5	5	5	5	5	5	5
Saturday	2	2	2	2	2	2	0	0	0	0	0	0
Sunday	2	2	2	2	2	2	0	0	0	0	0	0
DESIGN	5	2	2	2	2	2	2	2	0	0	0	0

PLANT DESCRIPTIONS

Plant : Unit #1 03-14-94

Prepared By : E.A.C., P.C. Burke, VA 6063092204

Carrier Hourly Analysis Program Page 1 of 1

****

1 PLANT NAME AND TYPES

Class	= Heat Pumps
Name	= Unit #1
Heat Pump Type	= Air Source Heat Pump
Auxiliary Plant Type	= Electrical Resistance

****

2 AIR SYSTEM SELECTION

Air System Name	Mult	Air System Name	Mult
Unit #1	1		

****

3 PLANT CHARACTERISTICS (Air Source Heat Pump)

COOLING DATA

Estimated maximum cooling coil load	= 2.52 Ton
Capacity at 95.0 F outdoor air	= 2.50 Ton
Input power rate at 95.0 F outdoor air	= 1.600 kW/Ton

HEATING DATA

Estimated maximum heating coil load	= 23.90 MBH
Capacity at 47.0 F outdoor air	= 35.0 MBH
Compressor, evaporator fan kW at 47.0 F outdoor air	= 4.0 kW
Outdoor air temperature for cutoff	= 42.0 F

AUXILIARY PLANT DATA

Plant type	= Electrical
Estimated maximum heating coil load	= 23.90 MBH
Type of heating	= Direct

****

4 PUMP SYSTEM DATA

(No inputs required)

****

AIR SYSTEM DESCRIPTION

Name : Unit #1 03-14-94
Carrier Hourly Analysis Program 6063092204
Prepared By : E.A.C., P.C. Burke, VA

****

1. SYSTEM NAME AND TYPE

System Name = Unit #1
System Class = Constant Volume
System Type = (SZCV) Single Zone Constant Volume
Operation Type = 3 Cooling & Heating
Type of Heating = 1 Central Heating

****

2. SPACE SELECTION (see separate printout)

****

3. THERMOSTAT & EQUIPMENT SCHEDULING DATA

Operation Period	Thermostat Setpoints Cooling	Thermostat Setpoints Heating	Ventilation Dampers
Occupied	78.0 F	70.0 F	OPEN
Unoccupied	78.0 F	70.0 F	OPEN

Weekday	: Occupied Period Begins at	6 ; Duration	= 17 hrs
Saturday	: Occupied Period Begins at	8 ; Duration	= 9 hrs
Sunday	: Occupied Period Begins at	8 ; Duration	= 9 hrs
Design Day	: Occupied Period Begins at	6 ; Duration	= 17 hrs

****

4. SUPPLY, VENTILATION, RETURN AIR DATA

SUPPLY AIR
Supply air temperature = 55.0 F
Heating supply temperature = 100.0 F
Fan operation for heating = 2 Cycled

VENTILATION AIR
Nominal ventilation flow rate = 0.00 % of supply air
Minimum ventilation flow rate = 0.00 % of supply air
Damper leak rate = 0 % of vent air

RETURN AIR
Zone exhaust air flow rate = 0.00 CFM
Zone exhaust fan power = 0.0 kW
Is a return plenum used ? N

****

****

5. FAN DATA

SUPPLY FAN

Type	=	2:Forward curved
Static	=	2.00 in wg
Efficiency	=	54 %
Configuration	=	1 Draw-thru

RETURN FAN

Type	=	1:(Fan does not exist)

****

6. ACCESSORY DEVICES AND SYSTEMS

PREHEAT COIL
(Not used)

OUTDOOR AIR ECONOMIZER CONTROL
(Not used)

VENTILATION AIR RECLAIM
(Not used)

HUMIDITY CONTROL
(Not used)

****

7. MISCELLANEOUS SYSTEM DATA

Cooling coil bypass factor	=	0.050
Type of supplemental heating	=	1 Not Used

****

AIR SYSTEM SPACE LIST

Name : Unit #1 03-14-94
Carrier Hourly Analysis Program 6063092204
Prepared By : E.A.C., P.C. Burke, VA

Space Name	Qty.	Space Name	Qty.
TABLE 1. SPACES IN ZONE 1			
1 Unit #1	x 1		

PLANT DESCRIPTIONS

1 PLANT NAME AND TYPES

Class = Heat Pumps
Name = Unit #2
Heat Pump Type = Air Source Heat Pump
Auxiliary Plant Type = Electrical Resistance

2 AIR SYSTEM SELECTION

Air System Name	Mult	Air System Name	Mult
Unit #2	1		

3 PLANT CHARACTERISTICS (Air Source Heat Pump)

COOLING DATA

Estimated maximum cooling coil load	=	3.45 Ton
Capacity at 95.0 F outdoor air	=	3.25 Ton
Input power rate at 95.0 F outdoor air	=	1.600 kW/Ton

HEATING DATA

Estimated maximum heating coil load	=	33.10 MBH
Capacity at 47.0 F outdoor air	=	45.0 MBH
Compressor, evaporator fan kW at 47.0 F outdoor air	=	5.2 kW
Outdoor air temperature for cutoff	=	42.0 F

AUXILIARY PLANT DATA

Plant type	=	Electrical
Estimated maximum heating coil load	=	33.10 MBH
Type of heating	=	Direct

4 PUMP SYSTEM DATA

(No inputs required)

4/1

AIR SYSTEM DESCRIPTION

Name : Unit #2 03-14-94
Carrier Hourly Analysis Program 6063092204
Prepared By : E.A.C., P.C. Burke, VA

****

1. SYSTEM NAME AND TYPE

System Name = Unit #2
System Class = Constant Volume
System Type = (SZCV) Single Zone Constant Volume
Operation Type = 3 Cooling & Heating
Type of Heating = 1 Central Heating

****

2. SPACE SELECTION (see separate printout)

****

3. THERMOSTAT & EQUIPMENT SCHEDULING DATA

Operation Period	Thermostat Setpoints Cooling	Thermostat Setpoints Heating	Ventilation Dampers
Occupied	78.0 F	70.0 F	OPEN
Unoccupied	78.0 F	70.0 F	OPEN

Weekday : Occupied Period Begins at 6 ; Duration = 17 hrs
Saturday : Occupied Period Begins at 8 ; Duration = 9 hrs
Sunday : Occupied Period Begins at 8 ; Duration = 9 hrs
Design Day : Occupied Period Begins at 6 ; Duration = 17 hrs

****

4. SUPPLY, VENTILATION, RETURN AIR DATA

SUPPLY AIR
Supply air temperature = 55.0 F
Heating supply temperature = 100.0 F
Fan operation for heating = 2 Cycled

VENTILATION AIR
Nominal ventilation flow rate = 0.00 % of supply air
Minimum ventilation flow rate = 0.00 % of supply air
Damper leak rate = 0 % of vent air

RETURN AIR
Zone exhaust air flow rate = 0.00 CFM
Zone exhaust fan power = 0.0 kW
Is a return plenum used ? N

****

****
5. FAN DATA

SUPPLY FAN

Type	=	2:Forward curved
Static	=	2.00 in wg
Efficiency	=	54 %
Configuration	=	1 Draw-thru

RETURN FAN

Type	=	1:(Fan does not exist)

****
6. ACCESSORY DEVICES AND SYSTEMS

PREHEAT COIL
(Not used)

OUTDOOR AIR ECONOMIZER CONTROL
(Not used)

VENTILATION AIR RECLAIM
(Not used)

HUMIDITY CONTROL
(Not used)

****
7. MISCELLANEOUS SYSTEM DATA

Cooling coil bypass factor	=	0.050
Type of supplemental heating	=	1 Not Used

****

AIR SYSTEM SPACE LIST

Name : Unit #2 03-14-94
Carrier Hourly Analysis Program 6063092204
Prepared By : E.A.C., P.C. Burke, VA Page 1

Space Name	Qty.	Space Name	Qty.
TABLE 1. SPACES IN ZONE 1			
2 Unit #2	x 1	7 Office-1	x 1
3 Comm. Center	x 1	8 Inproc. Rm	x 1
4 Office-2	x 1	9 Mens Room	x 1
5 Office-3	x 1	10 Womens Room	x 1
6 Briefing Room	x 1		

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1. SPACE NAME = Unit #1

2. WALL INFORMATION (Number of Wall Types = 1)

	Weight (lb/sqft)	Ext Color (D,M,L)	U-Value (BTU/hr/sqft/F)
Wall Type 1	L	L	0.077

	<-------- Net Wall Areas (sqft) -------->		
Exposure	Wall Type 1	Wall Type 2	Wall Type 3
NE	0.0	NA	NA
E	0.0	NA	NA
SE	0.0	NA	NA
S	490.0	NA	NA
SW	0.0	NA	NA
W	0.0	NA	NA
NW	0.0	NA	NA
N	0.0	NA	NA

3. ROOF INFORMATION (Number of Roof Types = 1)

	Weight (lb/sqft)	Ext Color (D,M,L)	U-Value (BTU/hr/sqft/F)	Area (sqft)
Roof 1	L	L	0.030	1,653.0

4. GLASS INFORMATION (Number of Glass Types = 1)

	U-Value (BTU/hr/sqft/F)	Glass Factor	Internal Shades
Glass Type 1	0.680	0.65	N

	<---------------- External Shading Information ---------------->						
	Window Height (ft)	Window Width (ft)	Reveal Depth (in)	Overhang Height (in)	Overhang Extension (in)	Fin Separation (in)	Fin Exten. (in)
Shade 1	5.0	1.0	12.0	36.0	36.0	0.0	0.0
Shade 2	8.0	4.0	0.0	0.0	0.0	0.0	0.0
Shade 3	8.0	4.0	0.0	0.0	0.0	0.0	0.0

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COMPLEX SPACE DESCRIPTION

4. GLASS INFORMATION (continued)

	Glass Areas (sqft)					
	Type 1		Type 2		Type 3	
Exposure	Area	Shade	Area	Shade	Area	Shade
NE	0.0	0	NA	NA	NA	NA
E	0.0	0	NA	NA	NA	NA
SE	0.0	0	NA	NA	NA	NA
S	10.0	1	NA	NA	NA	NA
SW	0.0	0	NA	NA	NA	NA
W	0.0	0	NA	NA	NA	NA
NW	0.0	0	NA	NA	NA	NA
N	0.0	0	NA	NA	NA	NA
H	0.0	0	NA	NA	NA	NA

5. INTERNAL LOADS

SPACE DATA : Floor Area = 1,395 sqft Building Wt. = L lb/sqft

PEOPLE : sqft/person = 697.5 Total People = 2
Schedule No. = 1 Activity Level = 4

LIGHTING : W/sqft = 1.72 Total Watts = 2,400
Schedule No. = 5 Wattage Mult. = 1.20
Fixture Type = 1 Recessed, not vented

OTHER ELECTRIC: W/sqft = 1.08 Total Watts = 1,500
Schedule No. = 2

MISC. SENSIBLE: Load = 0 BTU/hr Schedule No. = 1
MISC. LATENT : Load = 0 BTU/hr Schedule No. = 1

6. PARTITIONS, INFILTRATION, GROUND

PARTITIONS (Next to Unconditioned Spaces)	Area (sqft)	U-Value (BTU/hr/sqft/F)	Unconditioned Space Temp. Cooling (deg F or %)	Heating (deg F or %)
Walls	640.0	0.546	90.0 F	50.0 F
Ceilings	0.0	0.100	90.0 F	50.0 F
Floors	0.0	0.100	90.0 F	50.0 F

INFILTRATION			GROUND ELEMENT	
Cooling	: 0.10 CFM/sqft =	140 CFM	Area :	1,395.0 sqft
Heating	: 0.15 CFM/sqft =	209 CFM	Perimeter :	82.0 ft
Typical	: 0.10 CFM/sqft =	140 CFM	Depth :	0.0 ft

COMPLEX SPACE DESCRIPTION

Space Name : Unit #2 — 03-14-94
Prepared By : E.A.C., P.C. Burke, VA — 6063092204
Carrier Hourly Analysis Program —

1. SPACE NAME = Unit #2

2. WALL INFORMATION (Number of Wall Types = 1)

	Weight (lb/sqft)	Ext Color (D,M,L)	U-Value (BTU/hr/sqft/F)
Wall Type 1	L	L	0.077

	<-------- Net Wall Areas (sqft)	-------->	
Exposure	Wall Type 1	Wall Type 2	Wall Type 3
NE	0.0	NA	NA
E	0.0	NA	NA
SE	0.0	NA	NA
S	67.0	NA	NA
SW	0.0	NA	NA
W	83.5	NA	NA
NW	0.0	NA	NA
N	249.5	NA	NA

3. ROOF INFORMATION (Number of Roof Types = 1)

	Weight (lb/sqft)	Ext Color (D,M,L)	U-Value (BTU/hr/sqft/F)	Area (sqft)
Roof 1	L	L	0.030	465.0

4. GLASS INFORMATION (Number of Glass Types = 1)

	U-Value (BTU/hr/sqft/F)	Glass Factor	Internal Shades
Glass Type 1	0.680	0.65	N

	<---------------- External Shading Information ---------------->						
	Window Height (ft)	Window Width (ft)	Reveal Depth (in)	Overhang Height (in)	Overhang Extension (in)	Fin Separation (in)	Fin Exten. (in)
Shade 1	5.0	1.0	12.0	36.0	36.0	0.0	0.0
Shade 2	8.0	4.0	0.0	0.0	0.0	0.0	0.0
Shade 3	8.0	4.0	0.0	0.0	0.0	0.0	0.0

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4. GLASS INFORMATION (continued)

	Glass Areas (sqft)					
	Type 1		Type 2		Type 3	
Exposure	Area	Shade	Area	Shade	Area	Shade
NE	0.0	0	NA	NA	NA	NA
E	0.0	0	NA	NA	NA	NA
SE	0.0	0	NA	NA	NA	NA
S	0.0	0	NA	NA	NA	NA
SW	0.0	0	NA	NA	NA	NA
W	0.0	0	NA	NA	NA	NA
NW	0.0	0	NA	NA	NA	NA
N	0.0	0	NA	NA	NA	NA
H	0.0	0	NA	NA	NA	NA

5. INTERNAL LOADS

SPACE DATA	: Floor Area	=	369 sqft	Building Wt.	=	L lb/sqft
PEOPLE	: sqft/person	=	377.5	Total People	=	1
	Schedule No.	=	1	Activity Level	=	2
LIGHTING	: W/sqft	=	0.81	Total Watts	=	300
	Schedule No.	=	2	Wattage Mult.	=	1.20
	Fixture Type	=	1 Recessed, not vented			
OTHER ELECTRIC:	W/sqft	=	1.04	Total Watts	=	385
	Schedule No.	=	2			
MISC. SENSIBLE:	Load	=	0 BTU/hr	Schedule No.	=	1
MISC. LATENT	: Load	=	0 BTU/hr	Schedule No.	=	1

6. PARTITIONS, INFILTRATION, GROUND

PARTITIONS (Next to Unconditioned Spaces)	Area (sqft)	U-Value (BTU/hr/sqft/F)	Unconditioned Space Temp. Cooling (deg F or %)	Heating (deg F or %)
Walls	0.0	0.100	90.0 F	50.0 F
Ceilings	0.0	0.100	90.0 F	50.0 F
Floors	0.0	0.100	90.0 F	50.0 F

INFILTRATION			GROUND ELEMENT	
Cooling	: 0.10 CFM/sqft =	37 CFM	Area :	743.5 sqft
Heating	: 0.15 CFM/sqft =	55 CFM	Perimeter :	0.0 ft
Typical	: 0.10 CFM/sqft =	37 CFM	Depth :	0.0 ft.

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COMPLEX SPACE DESCRIPTION

Space Name : Comm. Center 03-14-94
Prepared By : E.A.C., P.C. Burke, VA 6063092204
Carrier Hourly Analysis Program

1. SPACE NAME = Comm. Center

2. WALL INFORMATION (Number of Wall Types = 1)

	Weight (lb/sqft)	Ext Color (D,M,L)	U-Value (BTU/hr/sqft/F)
Wall Type 1	L	L	0.077

	<-------- Net Wall Areas (sqft) -------->		
Exposure	Wall Type 1	Wall Type 2	Wall Type 3
NE	0.0	NA	NA
E	0.0	NA	NA
SE	0.0	NA	NA
S	0.0	NA	NA
SW	0.0	NA	NA
W	0.0	NA	NA
NW	0.0	NA	NA
N	148.5	NA	NA

3. ROOF INFORMATION (Number of Roof Types = 1)

	Weight (lb/sqft)	Ext Color (D,M,L)	U-Value (BTU/hr/sqft/F)	Area (sqft)
Roof 1	L	L	0.030	234.0

4. GLASS INFORMATION (Number of Glass Types = 1)

	U-Value (BTU/hr/sqft/F)	Glass Factor	Internal Shades
Glass Type 1	0.680	0.65	N

	<---------------- External Shading Information ---------------->						
	Window Height (ft)	Window Width (ft)	Reveal Depth (in)	Overhang Height (in)	Overhang Extension (in)	Fin Separation (in)	Fin Exten. (in)
Shade 1	5.0	1.0	12.0	36.0	36.0	0.0	0.0
Shade 2	8.0	4.0	0.0	0.0	0.0	0.0	0.0
Shade 3	8.0	4.0	0.0	0.0	0.0	0.0	0.0

COMPLEX SPACE DESCRIPTION

Space Name : Comm. Center 03-14-94
Prepared By : E.A.C., P.C. Burke, VA 6063092204
Carrier Hourly Analysis Program

****

4. GLASS INFORMATION (continued)

	Glass Areas (sqft)					
	Type 1		Type 2		Type 3	
Exposure	Area	Shade	Area	Shade	Area	Shade
NE	0.0	0	NA	NA	NA	NA
E	0.0	0	NA	NA	NA	NA
SE	0.0	0	NA	NA	NA	NA
S	0.0	0	NA	NA	NA	NA
SW	0.0	0	NA	NA	NA	NA
W	0.0	0	NA	NA	NA	NA
NW	0.0	0	NA	NA	NA	NA
N	7.5	1	NA	NA	NA	NA
H	0.0	0	NA	NA	NA	NA

****

5. INTERNAL LOADS

SPACE DATA : Floor Area = 185 sqft Building Wt. = L lb/sqft

PEOPLE : sqft/person = 0.0 Total People = 0
Schedule No. = 1 Activity Level = 2

LIGHTING : W/sqft = 2.59 Total Watts = 480
Schedule No. = 5 Wattage Mult. = 1.25
Fixture Type = 1 Recessed, not vented

OTHER ELECTRIC: W/sqft = 0.00 Total Watts = 0
Schedule No. = 2

MISC. SENSIBLE: Load = 0 BTU/hr Schedule No. = 1
MISC. LATENT : Load = 0 BTU/hr Schedule No. = 1

****

6. PARTITIONS, INFILTRATION, GROUND

PARTITIONS (Next to Unconditioned Spaces)	Area (sqft)	U-Value (BTU/hr/sqft/F)	Unconditioned Space Temp. Cooling (deg F or %)	Heating (deg F or %)
Walls	0.0	0.100	90.0 F	50.0 F
Ceilings	0.0	0.100	90.0 F	50.0 F
Floors	0.0	0.100	90.0 F	50.0 F

INFILTRATION			GROUND ELEMENT	
Cooling	: 0.10 CFM/sqft =	19 CFM	Area :	185.0 sqft
Heating	: 0.15 CFM/sqft =	28 CFM	Perimeter :	20.0 ft
Typical	: 0.10 CFM/sqft =	19 CFM	Depth :	0.0 ft

****

COMPLEX SPACE DESCRIPTION

Space Name : Office-2 03-14-94
Prepared By : E.A.C., P.C. Burke, VA 6063092204
Carrier Hourly Analysis Program

****

1. SPACE NAME = Office-2

****

2. WALL INFORMATION (Number of Wall Types = 1)

	Weight (lb/sqft)	Ext Color (D,M,L)	U-Value (BTU/hr/sqft/F)
Wall Type 1	L	L	0.077

Exposure	Net Wall Areas (sqft) Wall Type 1	Wall Type 2	Wall Type 3
NE	0.0	NA	NA
E	0.0	NA	NA
SE	0.0	NA	NA
S	0.0	NA	NA
SW	0.0	NA	NA
W	96.5	NA	NA
NW	0.0	NA	NA
N	80.0	NA	NA

****

3. ROOF INFORMATION (Number of Roof Types = 1)

	Weight (lb/sqft)	Ext Color (D,M,L)	U-Value (BTU/hr/sqft/F)	Area (sqft)
Roof 1	L	L	0.030	150.0

****

4. GLASS INFORMATION (Number of Glass Types = 1)

	U-Value (BTU/hr/sqft/F)	Glass Factor	Internal Shades
Glass Type 1	0.680	0.65	N

<---------------- External Shading Information ---------------->

	Window Height (ft)	Window Width (ft)	Reveal Depth (in)	Overhang Height (in)	Overhang Extension (in)	Fin Separation (in)	Fin Exten. (in)
Shade 1	5.0	1.0	12.0	36.0	36.0	0.0	0.0
Shade 2	8.0	4.0	0.0	0.0	0.0	0.0	0.0
Shade 3	8.0	4.0	0.0	0.0	0.0	0.0	0.0

****

4. GLASS INFORMATION (continued)

Exposure	Type 1 Area	Type 1 Shade	Type 2 Area	Type 2 Shade	Type 3 Area	Type 3 Shade
	<---- Glass Areas (sqft)					---->
NE	0.0	0	NA	NA	NA	NA
E	0.0	0	NA	NA	NA	NA
SE	0.0	0	NA	NA	NA	NA
S	0.0	0	NA	NA	NA	NA
SW	0.0	0	NA	NA	NA	NA
W	0.0	0	NA	NA	NA	NA
NW	0.0	0	NA	NA	NA	NA
N	7.5	1	NA	NA	NA	NA
H	0.0	0	NA	NA	NA	NA

5. INTERNAL LOADS

SPACE DATA	: Floor Area	=	130 sqft	Building Wt.	=	L lb/sqft
PEOPLE	: sqft/person	=	0.0	Total People	=	0
	Schedule No.	=	1	Activity Level	=	2
LIGHTING	: W/sqft	=	2.46	Total Watts	=	320
	Schedule No.	=	5	Wattage Mult.	=	1.25
	Fixture Type	=	1	Recessed, not vented		
OTHER ELECTRIC:	W/sqft	=	0.00	Total Watts	=	0
	Schedule No.	=	2			
MISC. SENSIBLE:	Load	=	0 BTU/hr	Schedule No.	=	1
MISC. LATENT	: Load	=	0 BTU/hr	Schedule No.	=	1

6. PARTITIONS, INFILTRATION, GROUND

PARTITIONS (Next to Unconditioned Spaces)	Area (sqft)	U-Value (BTU/hr/sqft/F)	Unconditioned Space Temp. Cooling (deg F or %)	Heating (deg F or %)
Walls	0.0	0.100	90.0 F	50.0 F
Ceilings	0.0	0.100	90.0 F	50.0 F
Floors	0.0	0.100	90.0 F	50.0 F

INFILTRATION			GROUND ELEMENT		
Cooling	: 0.10 CFM/sqft =	13 CFM	Area	:	130.0 sqft
Heating	: 0.15 CFM/sqft =	20 CFM	Perimeter	:	50.0 ft
Typical	: 0.10 CFM/sqft =	13 CFM	Depth	:	0.0 ft

COMPLEX SPACE DESCRIPTION

1. SPACE NAME = Office-3

2. WALL INFORMATION (Number of Wall Types = 1)

	Weight (lb/sqft)	Ext Color (D,M,L)	U-Value (BTU/hr/sqft/F)
Wall Type 1	L	L	0.077

Exposure	<-------- Net Wall Areas (sqft) --------> Wall Type 1	Wall Type 2	Wall Type 3
NE	0.0	NA	NA
E	0.0	NA	NA
SE	0.0	NA	NA
S	0.0	NA	NA
SW	0.0	NA	NA
W	0.0	NA	NA
NW	0.0	NA	NA
N	157.0	NA	NA

3. ROOF INFORMATION (Number of Roof Types = 1)

	Weight (lb/sqft)	Ext Color (D,M,L)	U-Value (BTU/hr/sqft/F)	Area (sqft)
Roof 1	L	L	0.030	258.0

4. GLASS INFORMATION (Number of Glass Types = 1)

	U-Value (BTU/hr/sqft/F)	Glass Factor	Internal Shades
Glass Type 1	0.680	0.65	N

	<---------------- External Shading Information ---------------->						
	Window Height (ft)	Window Width (ft)	Reveal Depth (in)	Overhang Height (in)	Overhang Extension (in)	Fin Separation (in)	Fin Exten. (in)
Shade 1	5.0	1.0	12.0	36.0	36.0	0.0	0.0
Shade 2	8.0	4.0	0.0	0.0	0.0	0.0	0.0
Shade 3	8.0	4.0	0.0	0.0	0.0	0.0	0.0

COMPLEX SPACE DESCRIPTION

Space Name : Office-3 | 03-14-94
Prepared By : E.A.C., P.C. Burke, VA | 6063092204
Carrier Hourly Analysis Program |

****

4. GLASS INFORMATION (continued)

	Glass Areas (sqft)					
	Type 1		Type 2		Type 3	
Exposure	Area	Shade	Area	Shade	Area	Shade
NE	0.0	0	NA	NA	NA	NA
E	0.0	0	NA	NA	NA	NA
SE	0.0	0	NA	NA	NA	NA
S	0.0	0	NA	NA	NA	NA
SW	0.0	0	NA	NA	NA	NA
W	0.0	0	NA	NA	NA	NA
NW	0.0	0	NA	NA	NA	NA
N	15.0	1	NA	NA	NA	NA
H	0.0	0	NA	NA	NA	NA

****

5. INTERNAL LOADS

SPACE DATA	: Floor Area	=	215 sqft	Building Wt.	=	L lb/sqft
PEOPLE	: sqft/person	=	0.0	Total People	=	0
	Schedule No.	=	1	Activity Level	=	2
LIGHTING	: W/sqft	=	2.23	Total Watts	=	480
	Schedule No.	=	5	Wattage Mult.	=	1.25
	Fixture Type	=	1 Recessed, not vented			
OTHER ELECTRIC:	W/sqft	=	0.00	Total Watts	=	0
	Schedule No.	=	2			
MISC. SENSIBLE:	Load	=	0 BTU/hr	Schedule No.	=	1
MISC. LATENT	: Load	=	0 BTU/hr	Schedule No.	=	1

****

6. PARTITIONS, INFILTRATION, GROUND

PARTITIONS (Next to Unconditioned Spaces)	Area (sqft)	U-Value (BTU/hr/sqft/F)	Unconditioned Space Temp. Cooling (deg F or %)	Heating (deg F or %)
Walls	0.0	0.100	90.0 F	50.0 F
Ceilings	0.0	0.100	90.0 F	50.0 F
Floors	0.0	0.100	90.0 F	50.0 F

INFILTRATION			GROUND ELEMENT	
Cooling	: 0.10 CFM/sqft =	22 CFM	Area :	215.0 sqft
Heating	: 0.15 CFM/sqft =	32 CFM	Perimeter :	40.0 ft
Typical	: 0.10 CFM/sqft =	22 CFM	Depth :	0.0 ft

****

COMPLEX SPACE DESCRIPTION

Space Name : Briefing Room — 03-14-94
Prepared By : E.A.C., P.C. Burke, VA — 6063092204
Carrier Hourly Analysis Program —

****

1. SPACE NAME = Briefing Room

****

2. WALL INFORMATION (Number of Wall Types = 1)

	Weight (lb/sqft)	Ext Color (D,M,L)	U-Value (BTU/hr/sqft/F)
Wall Type 1	L	L	0.077

	<-------- Net Wall Areas (sqft) -------->		
Exposure	Wall Type 1	Wall Type 2	Wall Type 3
NE	0.0	NA	NA
E	0.0	NA	NA
SE	0.0	NA	NA
S	233.0	NA	NA
SW	0.0	NA	NA
W	145.0	NA	NA
NW	0.0	NA	NA
N	0.0	NA	NA

****

3. ROOF INFORMATION (Number of Roof Types = 1)

	Weight (lb/sqft)	Ext Color (D,M,L)	U-Value (BTU/hr/sqft/F)	Area (sqft)
Roof 1	L	L	0.030	630.0

****

4. GLASS INFORMATION (Number of Glass Types = 1)

	U-Value (BTU/hr/sqft/F)	Glass Factor	Internal Shades
Glass Type 1	0.680	0.65	N

	<---------------- External Shading Information ---------------->						
	Window Height (ft)	Window Width (ft)	Reveal Depth (in)	Overhang Height (in)	Overhang Extension (in)	Fin Separation (in)	Fin Exten. (in)
Shade 1	5.0	1.0	12.0	36.0	36.0	0.0	0.0
Shade 2	8.0	4.0	0.0	0.0	0.0	0.0	0.0
Shade 3	8.0	4.0	0.0	0.0	0.0	0.0	0.0

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4. GLASS INFORMATION (continued)

	<------------------ Glass Areas (sqft)				----------------->	
	Type 1		Type 2		Type 3	
Exposure	Area	Shade	Area	Shade	Area	Shade
NE	0.0	0	NA	NA	NA	NA
E	0.0	0	NA	NA	NA	NA
SE	0.0	0	NA	NA	NA	NA
S	15.0	1	NA	NA	NA	NA
SW	0.0	0	NA	NA	NA	NA
W	15.0	1	NA	NA	NA	NA
NW	0.0	0	NA	NA	NA	NA
N	0.0	0	NA	NA	NA	NA
H	0.0	0	NA	NA	NA	NA

****

5. INTERNAL LOADS

SPACE DATA	: Floor Area	=	600 sqft	Building Wt. =	L	lb/sqft
PEOPLE	: sqft/person	=	0.0	Total People	=	0
	Schedule No.	=	1	Activity Level	=	2
LIGHTING	: W/sqft	=	1.60	Total Watts	=	960
	Schedule No.	=	5	Wattage Mult.	=	1.20
	Fixture Type	=	1	Recessed, not vented		
OTHER ELECTRIC:	W/sqft	=	0.00	Total Watts	=	0
	Schedule No.	=	2			
MISC. SENSIBLE:	Load	=	0 BTU/hr	Schedule No.	=	1
MISC. LATENT	: Load	=	0 BTU/hr	Schedule No.	=	1

****

6. PARTITIONS, INFILTRATION, GROUND

PARTITIONS (Next to Unconditioned Spaces)			Unconditioned Space Temp.	
	Area (sqft)	U-Value (BTU/hr/sqft/F)	Cooling (deg F or %)	Heating (deg F or %)
Walls	0.0	0.100	90.0 F	50.0 F
Ceilings	0.0	0.100	90.0 F	50.0 F
Floors	0.0	0.100	90.0 F	50.0 F

INFILTRATION			GROUND ELEMENT		
Cooling	: 0.10 CFM/sqft =	60 CFM	Area	:	600.0 sqft
Heating	: 0.15 CFM/sqft =	90 CFM	Perimeter	:	75.0 ft
Typical	: 0.10 CFM/sqft =	60 CFM	Depth	:	0.0 ft

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COMPLEX SPACE DESCRIPTION

Space Name : Office-1 03-14-94
Prepared By : E.A.C., P.C. Burke, VA 6063092204
Carrier Hourly Analysis Program

1. SPACE NAME = Office-1

2. WALL INFORMATION (Number of Wall Types = 1)

	Weight (lb/sqft)	Ext Color (D,M,L)	U-Value (BTU/hr/sqft/F)
Wall Type 1	L	L	0.077

Exposure	Net Wall Areas (sqft) Wall Type 1	Wall Type 2	Wall Type 3
NE	0.0	NA	NA
E	0.0	NA	NA
SE	0.0	NA	NA
S	0.0	NA	NA
SW	0.0	NA	NA
W	0.0	NA	NA
NW	0.0	NA	NA
N	0.0	NA	NA

3. ROOF INFORMATION (Number of Roof Types = 1)

	Weight (lb/sqft)	Ext Color (D,M,L)	U-Value (BTU/hr/sqft/F)	Area (sqft)
Roof 1	L	L	0.030	135.0

4. GLASS INFORMATION (Number of Glass Types = 1)

	U-Value (BTU/hr/sqft/F)	Glass Factor	Internal Shades
Glass Type 1	0.680	0.65	N

External Shading Information

	Window Height (ft)	Window Width (ft)	Reveal Depth (in)	Overhang Height (in)	Overhang Extension (in)	Fin Separation (in)	Fin Exten. (in)
Shade 1	5.0	1.0	12.0	36.0	36.0	0.0	0.0
Shade 2	8.0	4.0	0.0	0.0	0.0	0.0	0.0
Shade 3	8.0	4.0	0.0	0.0	0.0	0.0	0.0

4. GLASS INFORMATION (continued)

	Glass Areas (sqft)					
	Type 1		Type 2		Type 3	
Exposure	Area	Shade	Area	Shade	Area	Shade
NE	0.0	0	NA	NA	NA	NA
E	0.0	0	NA	NA	NA	NA
SE	0.0	0	NA	NA	NA	NA
S	0.0	0	NA	NA	NA	NA
SW	0.0	0	NA	NA	NA	NA
W	0.0	0	NA	NA	NA	NA
NW	0.0	0	NA	NA	NA	NA
N	0.0	0	NA	NA	NA	NA
H	0.0	0	NA	NA	NA	NA

5. INTERNAL LOADS

SPACE DATA : Floor Area = 13 sqft Building Wt. = L lb/sqft

PEOPLE : sqft/person = 377.5 Total People = 0
Schedule No. = 1 Activity Level = 2

LIGHTING : W/sqft = 24.62 Total Watts = 320
Schedule No. = 5 Wattage Mult. = 1.20
Fixture Type = 1 Recessed, not vented

OTHER ELECTRIC: W/sqft = 0.00 Total Watts = 0
Schedule No. = 2

MISC. SENSIBLE: Load = 0 BTU/hr Schedule No. = 1
MISC. LATENT : Load = 0 BTU/hr Schedule No. = 1

6. PARTITIONS, INFILTRATION, GROUND

PARTITIONS (Next to Unconditioned Spaces)	Area (sqft)	U-Value (BTU/hr/sqft/F)	Unconditioned Space Temp. Cooling (deg F or %)	Heating (deg F or %)
Walls	0.0	0.100	90.0 F	50.0 F
Ceilings	0.0	0.100	90.0 F	50.0 F
Floors	0.0	0.100	90.0 F	50.0 F

INFILTRATION			GROUND ELEMENT	
Cooling	: 0.10 CFM/sqft =	1 CFM	Area :	0.0 sqft
Heating	: 0.15 CFM/sqft =	2 CFM	Perimeter :	0.0 ft
Typical	: 0.10 CFM/sqft =	1 CFM	Depth :	0.0 ft

1. SPACE NAME = Inproc. Rm

2. WALL INFORMATION (Number of Wall Types = 1)

	Weight (lb/sqft)	Ext Color (D,M,L)	U-Value (BTU/hr/sqft/F)
Wall Type 1	L	L	0.077

Exposure	<-------- Net Wall Areas (sqft) --------> Wall Type 1	Wall Type 2	Wall Type 3
NE	0.0	NA	NA
E	0.0	NA	NA
SE	0.0	NA	NA
S	0.0	NA	NA
SW	0.0	NA	NA
W	119.0	NA	NA
NW	0.0	NA	NA
N	0.0	NA	NA

3. ROOF INFORMATION (Number of Roof Types = 1)

	Weight (lb/sqft)	Ext Color (D,M,L)	U-Value (BTU/hr/sqft/F)	Area (sqft)
Roof 1	L	L	0.030	400.0

4. GLASS INFORMATION (Number of Glass Types = 1)

	U-Value (BTU/hr/sqft/F)	Glass Factor	Internal Shades
Glass Type 1	0.680	0.65	N

<---------------- External Shading Information ---------------->

	Window Height (ft)	Window Width (ft)	Reveal Depth (in)	Overhang Height (in)	Overhang Extension (in)	Fin Separation (in)	Fin Exten. (in)
Shade 1	5.0	1.0	12.0	36.0	36.0	0.0	0.0
Shade 2	8.0	4.0	0.0	0.0	0.0	0.0	0.0
Shade 3	8.0	4.0	0.0	0.0	0.0	0.0	0.0

COMPLEX SPACE DESCRIPTION

Space Name : Inproc. Rm
Prepared By : E.A.C., P.C. Burke, VA
Carrier Hourly Analysis Program

4. GLASS INFORMATION (continued)

	Glass Areas (sqft)					
	Type 1		Type 2		Type 3	
Exposure	Area	Shade	Area	Shade	Area	Shade
NE	0.0	0	NA	NA	NA	NA
E	0.0	0	NA	NA	NA	NA
SE	0.0	0	NA	NA	NA	NA
S	0.0	0	NA	NA	NA	NA
SW	0.0	0	NA	NA	NA	NA
W	15.0	0	NA	NA	NA	NA
NW	0.0	0	NA	NA	NA	NA
N	0.0	0	NA	NA	NA	NA
H	0.0	0	NA	NA	NA	NA

5. INTERNAL LOADS

SPACE DATA	: Floor Area	=	383 sqft	Building Wt.	=	L lb/sqft
PEOPLE	: sqft/person	=	0.0	Total People	=	0
	Schedule No.	=	1	Activity Level	=	2
LIGHTING	: W/sqft	=	2.09	Total Watts	=	800
	Schedule No.	=	2	Wattage Mult.	=	1.20
	Fixture Type	=	1 Recessed, not vented			
OTHER ELECTRIC:	W/sqft	=	0.00	Total Watts	=	0
	Schedule No.	=	2			
MISC. SENSIBLE:	Load	=	0 BTU/hr	Schedule No.	=	1
MISC. LATENT	: Load	=	0 BTU/hr	Schedule No.	=	1

6. PARTITIONS, INFILTRATION, GROUND

PARTITIONS (Next to Unconditioned Spaces)	Area (sqft)	U-Value (BTU/hr/sqft/F)	Unconditioned Space Temp. Cooling (deg F or %)	Heating (deg F or %)
Walls	0.0	0.100	90.0 F	50.0 F
Ceilings	0.0	0.100	90.0 F	50.0 F
Floors	0.0	0.100	90.0 F	50.0 F

INFILTRATION			GROUND ELEMENT	
Cooling	: 0.10 CFM/sqft =	38 CFM	Area :	382.5 sqft
Heating	: 0.15 CFM/sqft =	57 CFM	Perimeter :	20.0 ft
Typical	: 0.10 CFM/sqft =	38 CFM	Depth :	0.0 ft

430

COMPLEX SPACE DESCRIPTION

Space Name : Mens Room 03-14-94
Prepared By : E.A.C., P.C. Burke, VA 6063092204
Carrier Hourly Analysis Program

1. SPACE NAME = Mens Room

2. WALL INFORMATION (Number of Wall Types = 1)

	Weight (lb/sqft)	Ext Color (D,M,L)	U-Value (BTU/hr/sqft/F)
Wall Type 1	L	L	0.077

Exposure	<-------- Net Wall Areas (sqft) --------> Wall Type 1	Wall Type 2	Wall Type 3
NE	0.0	NA	NA
E	0.0	NA	NA
SE	0.0	NA	NA
S	0.0	NA	NA
SW	0.0	NA	NA
W	0.0	NA	NA
NW	0.0	NA	NA
N	0.0	NA	NA

3. ROOF INFORMATION (Number of Roof Types = 1)

	Weight (lb/sqft)	Ext Color (D,M,L)	U-Value (BTU/hr/sqft/F)	Area (sqft)
Roof 1	L	L	0.030	225.0

4. GLASS INFORMATION (Number of Glass Types = 1)

	U-Value (BTU/hr/sqft/F)	Glass Factor	Internal Shades
Glass Type 1	0.680	0.65	N

	<------ External Shading Information ------>						
	Window Height (ft)	Window Width (ft)	Reveal Depth (in)	Overhang Height (in)	Overhang Extension (in)	Fin Separation (in)	Fin Exten. (in)
Shade 1	5.0	1.0	12.0	36.0	36.0	0.0	0.0
Shade 2	8.0	4.0	0.0	0.0	0.0	0.0	0.0
Shade 3	8.0	4.0	0.0	0.0	0.0	0.0	0.0

4. GLASS INFORMATION (continued)

	Glass Areas (sqft)					
	Type 1		Type 2		Type 3	
Exposure	Area	Shade	Area	Shade	Area	Shade
NE	0.0	0	NA	NA	NA	NA
E	0.0	0	NA	NA	NA	NA
SE	0.0	0	NA	NA	NA	NA
S	0.0	0	NA	NA	NA	NA
SW	0.0	0	NA	NA	NA	NA
W	0.0	0	NA	NA	NA	NA
NW	0.0	0	NA	NA	NA	NA
N	0.0	0	NA	NA	NA	NA
H	0.0	0	NA	NA	NA	NA

5. INTERNAL LOADS

SPACE DATA	: Floor Area	= 212 sqft	Building Wt.	=	L lb/sqft
PEOPLE	: sqft/person	= 0.0	Total People	=	0
	Schedule No.	= 1	Activity Level	=	2
LIGHTING	: W/sqft	= 2.48	Total Watts	=	525
	Schedule No.	= 6	Wattage Mult.	=	1.00
	Fixture Type	= 1	Recessed, not vented		
OTHER ELECTRIC:	W/sqft	= 0.00	Total Watts	=	0
	Schedule No.	= 2			
MISC. SENSIBLE:	Load	= 0 BTU/hr	Schedule No.	=	1
MISC. LATENT	: Load	= 0 BTU/hr	Schedule No.	=	1

6. PARTITIONS, INFILTRATION, GROUND

PARTITIONS (Next to Unconditioned Spaces)	Area (sqft)	U-Value (BTU/hr/sqft/F)	Unconditioned Space Temp. Cooling (deg F or %)	Heating (deg F or %)
Walls	0.0	0.100	90.0 F	50.0 F
Ceilings	0.0	0.100	90.0 F	50.0 F
Floors	0.0	0.100	90.0 F	50.0 F

INFILTRATION			GROUND ELEMENT	
Cooling	: 0.10 CFM/sqft =	21 CFM	Area :	212.0 sqft
Heating	: 0.15 CFM/sqft =	32 CFM	Perimeter :	0.0 ft
Typical	: 0.10 CFM/sqft =	21 CFM	Depth :	0.0 ft

437

COMPLEX SPACE DESCRIPTION

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1. SPACE NAME = Womens Room

****

2. WALL INFORMATION (Number of Wall Types = 1)

	Weight (lb/sqft)	Ext Color (D,M,L)	U-Value (BTU/hr/sqft/F)
Wall Type 1	L	L	0.077

Exposure	<-------- Net Wall Areas (sqft) --------> Wall Type 1	Wall Type 2	Wall Type 3
NE	0.0	NA	NA
E	0.0	NA	NA
SE	0.0	NA	NA
S	0.0	NA	NA
SW	0.0	NA	NA
W	0.0	NA	NA
NW	0.0	NA	NA
N	0.0	NA	NA

****

3. ROOF INFORMATION (Number of Roof Types = 1)

	Weight (lb/sqft)	Ext Color (D,M,L)	U-Value (BTU/hr/sqft/F)	Area (sqft)
Roof 1	L	L	0.030	47.0

****

4. GLASS INFORMATION (Number of Glass Types = 1)

	U-Value (BTU/hr/sqft/F)	Glass Factor	Internal Shades
Glass Type 1	0.680	0.65	N

	<---------------- External Shading Information ---------------->						
	Window Height (ft)	Window Width (ft)	Reveal Depth (in)	Overhang Height (in)	Overhang Extension (in)	Fin Separation (in)	Fin Exten. (in)
Shade 1	5.0	1.0	12.0	36.0	36.0	0.0	0.0
Shade 2	8.0	4.0	0.0	0.0	0.0	0.0	0.0
Shade 3	8.0	4.0	0.0	0.0	0.0	0.0	0.0

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4. GLASS INFORMATION (continued)

Exposure	Glass Areas (sqft) Type 1 Area	Type 1 Shade	Type 2 Area	Type 2 Shade	Type 3 Area	Type 3 Shade
NE	0.0	0	NA	NA	NA	NA
E	0.0	0	NA	NA	NA	NA
SE	0.0	0	NA	NA	NA	NA
S	0.0	0	NA	NA	NA	NA
SW	0.0	0	NA	NA	NA	NA
W	0.0	0	NA	NA	NA	NA
NW	0.0	0	NA	NA	NA	NA
N	0.0	0	NA	NA	NA	NA
H	0.0	0	NA	NA	NA	NA

****

5. INTERNAL LOADS

SPACE DATA	: Floor Area	=	42 sqft	Building Wt. =	L lb/sqft
PEOPLE	: sqft/person	=	377.5	Total People =	0
	Schedule No.	=	1	Activity Level =	2
LIGHTING	: W/sqft	=	1.79	Total Watts =	75
	Schedule No.	=	6	Wattage Mult. =	1.00
	Fixture Type	=	1 Recessed, not vented		
OTHER ELECTRIC:	W/sqft	=	0.00	Total Watts =	0
	Schedule No.	=	2		
MISC. SENSIBLE:	Load	=	0 BTU/hr	Schedule No. =	1
MISC. LATENT	: Load	=	0 BTU/hr	Schedule No. =	1

****

6. PARTITIONS, INFILTRATION, GROUND

PARTITIONS (Next to Unconditioned Spaces)	Area (sqft)	U-Value (BTU/hr/sqft/F)	Unconditioned Space Temp. Cooling (deg F or %)	Heating (deg F or %)
Walls	0.0	0.100	90.0 F	50.0 F
Ceilings	0.0	0.100	90.0 F	50.0 F
Floors	0.0	0.100	90.0 F	50.0 F

INFILTRATION			GROUND ELEMENT	
Cooling	: 0.10 CFM/sqft =	4 CFM	Area :	1,510.0 sqft
Heating	: 0.15 CFM/sqft =	6 CFM	Perimeter :	122.0 ft
Typical	: 0.10 CFM/sqft =	4 CFM	Depth :	0.0 ft

****

Base Building Simulation Data

ENERGY BUDGET <A>

Building : #1253 - FORT A.P. HILL 02-15-94
Site : FORT A.P. HILL, Virginia 6063092204
Prepared By : E.A.C., P.C. Burke, VA
Carrier Hourly Analysis Program

TABLE 1. ANNUAL LOADS

Component	(kBTU)	(kBTU/sqft)*
Cooling Loads *	168,225	33.645
Heating Loads *	13,154	2.631

TABLE 2. ENERGY BY SYSTEM COMPONENT

Component	Site Energy (kBTU)	Site Energy (kBTU/sqft)*	Source Energy (kBTU)	Source Energy (kBTU/sqft)*
Air System Fans	24,338	4.868	24,834	4.967
Cooling Plants	72,977	14.595	74,467	14.893
Heating Plants	11,802	2.360	12,043	2.409
Pumps	0	0.000	0	0.000
>> HVAC Total	109,117	21.823	111,344	22.269
Lights	117,545	23.509	119,944	23.989
Other Electric	42,081	8.416	42,939	8.588
Misc. Electric	0	0.000	0	0.000
Dom. Hot Water	11,985	2.397	12,230	2.446
>> Non-HVAC Total	171,611	34.322	175,113	35.023
>> GRAND TOTAL	280,728	56.146	286,457	57.291

* Notes:
1. Site energy is the actual energy consumed.
2. Source energy accounts for electrical generating inefficiencies. For this study:
   Electric generating efficiency = 98.0 %
3. Energy per unit floor area is based on the gross building floor area. For this building:
   Gross floor area = 5,000 sqft
   Conditioned floor area = 3,660 sqft
4. Annual cooling load is the sum of all cooling plant loads.
5. Annual heating load is the sum of all primary and auxiliary heating plant loads. It does not include the domestic water heating load.

ENERGY BUDGET <B>

Building : #1253 - FORT A.P. HILL — 02-15-94
Site : FORT A.P. HILL, Virginia — 6063092204
Prepared By : E.A.C., P.C. Burke, VA
Carrier Hourly Analysis Program

TABLE 1. ANNUAL LOADS

Component	(kBTU)	(kBTU/sqft)*
Cooling Loads *	168,225	33.645
Heating Loads *	13,154	2.631

TABLE 2. ENERGY BY ENERGY COMPONENT

	<----- Site Energy ----->		<---- Source Energy ---->	
Component	(kBTU)	(kBTU/sqft)*	(kBTU)	(kBTU/sqft)*
Electric	109,117	21.823	111,344	22.269
Natural Gas	0	0.000	0	0.000
Fuel Oil	0	0.000	0	0.000
Propane	0	0.000	0	0.000
Remote Heating	0	0.000	0	0.000
Remote Cooling	0	0.000	0	0.000
>> HVAC Total	109,117	21.823	111,344	22.269
Electric	171,611	34.322	175,113	35.023
Natural Gas	0	0.000	0	0.000
Fuel Oil	0	0.000	0	0.000
Propane	0	0.000	0	0.000
Remote Heating	0	0.000	0	0.000
>> Non-HVAC Total	171,611	34.322	175,113	35.023
>> GRAND TOTAL	280,728	56.146	286,457	57.291

* Notes:
1. Site energy is the actual energy consumed.
2. Source energy accounts for electrical generating inefficiencies. For this study:
   Electric generating efficiency = 98.0 %
3. Energy per unit floor area is based on the gross building floor area. For this building:
   Gross floor area = 5,000 sqft
   Conditioned floor area = 3,660 sqft
4. Annual cooling load is the sum of all cooling plant loads.
5. Annual heating load is the sum of all primary and auxiliary heating plant loads. It does not include the domestic water heating load.

Stand Alone Energy Conservation Opporutnities

[he list of ECO's discussed at the interim review meeting were analyzed to determined if any of the ECO's were applicable to the study building. The ECO's listed below are applicable for this study building. Each ECO was simulated as a stand alone ECO so that a ranking could be determined based on the ascending order of SIR's and the simple payback periods. If the SIR's were greater than 1.25 and the simple payback was about 10 years for the stand alone ECO , then the ECO was selected for further study and synergistic effects were then taken into account.

The Following ECO's have been arranged according to their SIR's. ECO's with SIR's greater than 1.25, and a simple payback period of about 10 years, were then selected for further evaluation (Synergistic Effects). These ECO's only apply to Building .253

Stand Alone ECO's (No Synergistic Effects)

ECO	Construction Cost	Energy Savings (Mbtu)	$ Savings	Simple Payback	SIR
Low Flow Shower Heads	45	11.2	231	0.19	67.59
Occupancy Sensors	900	31.0	573	1.57	7.52
F32 T-8 Lighting System	2,700	73.6	1,358	1.99	5.95
Energy Savings Fluor. Lamps	1,000	23.7	438	2.28	5.17
Compact Fluor. Lights	300	6.93	127	2.36	5.04
Daylight Dimming Controls	1,600	17.2	318	5.03	2.35
Exit Sign Retrofit	800	5.38	150	5.3	1.47
Economizer Controls	5,000	24.0	444	11.2	0.75
Water Heater Controls	85	.112	3	28	0.48

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Low Flow Shower Heads

LIFE CYCLE COST ANALYSIS SUMMARY
WITH SYNERGISTIC EFFECTS

LOCATION: Fort A.P. Hill, Virginia
REGION: 3
PROJECT NO.: DACA 31-89-C-0198
PROJECT TITLE: Fort A.P. Hill- Energy Engineering Analysis Program
FISCAL YEAR: 1994
DISCRETE PORTION NAME: Low Flow Shower Heads
ANALYSIS DATE: January 1994
ECONOMIC LIFE (YRS 20
PREPARER: JJS

1. INVESTMENT COSTS:

A. CONSTRUCTION COST	$	45	
B. SIOH	$	2	
C. DESIGN COST	$	3	
D. TOTAL COST (1A+1B+1C)	$	50	
E. SALVAGE VALUE OF EXISTING EQUIPMENT			
F. PUBLIC UTILITY COMPANY REBATE			
G. TOTAL INVESTMENT (1D-1E-1F)			$50

2. ENERGY SAVINGS (+)/COST(-):

DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS- Oct 1992

ENERGY SOURCE	COST $/MBTU(1)	SAVING(S) MBTU/YR(2)	ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELEC	$20.67	11.2	$ 232	14.65	$ 3,392
B. DIST	$5.69		$	17.70	$
C. RESID			$		$
D. NG			$		$
E. LPG	$7.76		$	20.60	$
F. COAL			$		$
G. SOLAR			$		$
H. GEOTH			$		$
I. BIOMA			$		$
J. REFUS			$		$
K. WIND			$		$
L. OTHER			$		$
M. DEMAND SAVINGS			$		$
N. TOTAL		11	$ 232		$ 3,392

3. NON ENERGY SAVINGS (+) OR COST (-):

A. ANNUAL RECURRING (+/-)
(1) DISCOUNT FACTOR (TABLE A)
(2) DISCOUNTED SAVINGS/COST (3A X 3A1)

B. NON RECURRING SAVINGS (+) OR COST (-)

ITEM	SAVINGS(+) COST(-)(1)	YEAR OF OCCUR. (2)	DISCOUNT FACTOR(3)	DISCOUNTED SAVINGS(+)COST(-)(4)
a.	$			$
b.	$			$
c.	$			$
d. TOTAL				$

C. TOTAL NON ENERGY DISCOUNTED SAVINGS (3A2+3Bd4)

4. SIMPLE PAYBACK 1G/(2N3+3A+(3Bd1/ECONOMIC LIFE)):	0.22 YEARS
5. TOTAL NET DISCOUNTED SAVINGS (2N5+3C):	$3,392
6. SAVINGS TO INVESTMENT RATION (SIR) 5/1G:	67.59
7. ADJUSTED INTERNAL RATE OF RETURN (AIRR):	24.39%

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CONSTRUCTION COST ESTIMATE	PREPARED: March 1994 SHEET 1 OF 2
PROJECT: Energy Savings Oppurtunity Survey LOCATION: Fort A.P. Hill, Virginia AE PROJECT NO.: 92008 AE: Engineering Applications Consultants, P.C.	CONTRACT NO.: DACA 31-89-C-0198 ESTIMATOR: JS PRELIM: CHECKED BY: VP FINAL: X

SUMMARY: Low Flow Shower Heads

ITEM	QUANTITY		MATERIAL		LABOR		TOTAL COST
	NO.	MEAS	UNIT	COST	UNIT	COST	
Building 1253							
Low Flow Shower Heads	1	EA	25.00	25	7.00	7	32
SUB-TOTAL				25		7	32

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CONSTRUCTION COST ESTIMATE

PREPARED: March 1994 SHEET 2 OF 2

PROJECT: Energy Savings Oppurtunity Survey

CONTRACT NO.: DACA 31-89-C-0198

LOCATION: Fort A.P. Hill, Virginia
AE PROJECT NO.:
AE: Engineering Applications Consultants, P.C.

ESTIMATOR: JS PRELIM:
CHECKED BY: VP FINAL: X

SUMMARY: Low Flow Shower Heads

ITEM	QUANTITY		MATERIAL		LABOR		TOTAL COST
	NO.	MEAS	UNIT	COST	UNIT	COST	
SUBTOTAL PREVIOUS PAGE				25		7	32
MARK-UP ON LABOR SUB-TOTAL	21.0%			—		1	1 33
TAXES ON MATERIAL SUB-TOTAL	5.0%			1		----	1 35
OVERHEAD SUB-TOTAL	15.0%						5 40
PROFIT SUB-TOTAL	12.0%						5 45
PRIME MARK-UP ON SUB SUB-TOTAL							45
GRAND TOTAL							

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ENGINEERING ANALYSIS

Sheet ____ of ____

By: JS

LOW FLOW SHOWER HEADS - ADMIN

Project: Fort A. P. Hill ESOS | Date: 2-28-94

Contract No.: DACA 31-89-C-0198 | EAC Project No.: 92008

EXISTING CONDITIONS: 1 SHOWER HEAD, 5.5 gpm
- ELECTRIC HOT WATER HEATER (40 gal) (EFFICIENCY = 98%)

ASSUMPTIONS
- BASED ON FIELD survey data assume 3 showers per day.
- Use 6 MIN AVG. LENGTH OF SHOWER

WATER USAGE: $\frac{6\ \text{MIN}}{\text{SHOWER}} \times \frac{5.5\ \text{gal}}{\text{MIN}} \times \frac{3\ \text{showers}}{\text{day}} = 99$ gal per day

$$Q = \left(\frac{1}{\text{EFF}}\right)\dot{m}\,C_p\,\Delta T = \frac{99\ \text{gal}}{\text{day}} \times \frac{8.3\ \text{lbm}}{1\ \text{gal}\ H_2O} \times \frac{1\ \text{day}}{24\ \text{hrs}} \times \frac{.999\ \text{BTU}}{\text{lbm}\ {}^\circ F} \times (120-55) \times \frac{1}{.98}$$

$$= 2343\ \frac{\text{Btu}}{\text{HR}} = .562\ \frac{\text{MBtu}}{\text{day}} = 20.5\ \text{MBTU/YR}$$

Reduce usage to 2.5 gpm

$$Q = \frac{1}{\text{EFF}}\dot{m}C_p\Delta T \qquad \frac{6\ \text{MIN}}{\text{SHOWER}} \times \frac{2.5\ \text{gal}}{\text{MIN}} \times \frac{3\ \text{SHOWERS}}{\text{day}} = 45\ \text{gal per day}$$

$$= \frac{1}{.98}\left(\frac{45\ \text{gal}}{\text{day}} \times \frac{8.3\ \text{lbm}}{\text{gal}\ H_2O} \times \frac{1\ \text{day}}{24\ \text{hrs}}\right) \times \frac{.999\ \text{Btu}}{\text{lbm}\ {}^\circ F} \times (120-55) = 1064\ \text{Btu/HR}$$

$$= 9.32\ \text{MBTU/YR}$$

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ENGINEERING ANALYSIS

Sheet ____ of ____

By: ____

Project: Fort A. P. Hill ESOS

Date: 2-28-94

Contract No.: DACA 31-89-C-0198

EAC Project No.: 92008

FOR EXISTING SHOWER HEAD ENERGY USAGE = 20.5 MBtu/YR

ENERGY EFFICIENT (2.5 gpm) Shower Head Energy Usage = −9.3 MBtu/YR

Savings per year = 11.2 MBtu/YR

Savings per Ft² FLOOR AREA (5000 Ft²) = .0022 MBtu/YR/Ft²

Group Savings = .0022 MBtu/YR/Ft² * 11,800
= 25.96 MBtu

$ Savings = 25.96 MBtu × $18.54 / MBtu
= $481

(Assume 1 per BLG)
Use 3 Shower Heads

Occupancy Sensors

LIFE CYCLE COST ANALYSIS SUMMARY
WITH SYNERGISTIC EFFECTS

LOCATION: Fort A.P. Hill, Virginia
PROJECT TITLE: Fort A.P. Hill- Energy Engineering Analysis Program
DISCRETE PORTION NAME: Occupancy Sensors
ANALYSIS DATE: January 1994
REGION: 3
PROJECT NO.: DACA 31-89-C-0198
FISCAL YEAR: 1994
ECONOMIC LIFE (YRS 15
PREPARER: JJS

1. INVESTMENT COSTS:

A. CONSTRUCTION COST	$ 900	
B. SIOH	$ 50	
C. DESIGN COST	$ 54	
D. TOTAL COST (1A+1B+1C)	$ 1,004	
E. SALVAGE VALUE OF EXISTING EQUIPMENT		
F. PUBLIC UTILITY COMPANY REBATE		
G. TOTAL INVESTMENT (1D-1E-1F)		$1,004

2. ENERGY SAVINGS (+)/COST(-):

DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS- Oct 1992

ENERGY SOURCE	COST $/MBTU(1)	SAVING(S) MBTU/YR(2)	ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELEC	$20.67	31.0	$ 641	11.77	$ 7,542
B. DIST	$5.69		$	13.83	$
C. RESID			$		$
D. NG			$		$
E. LPG	$7.76		$	15.34	$
F. COAL			$		$
G. SOLAR			$		$
H. GEOTH			$		$
I. BIOMA			$		$
J. REFUS			$		$
K. WIND			$		$
L. OTHER			$		$
M. DEMAND SAVINGS			$		$
N. TOTAL		31	$ 641		$ 7,542

3. NON ENERGY SAVINGS (+) OR COST (-):

A. ANNUAL RECURRING (+/-)
(1) DISCOUNT FACTOR (TABLE A)
(2) DISCOUNTED SAVINGS/COST (3A X 3A1)

B. NON RECURRING SAVINGS (+) OR COST (-)

ITEM	SAVINGS(+) COST(-)(1)	YEAR OF OCCUR. (2)	DISCOUNT FACTOR(3)	DISCOUNTED SAV-INGS(+)COST(-)(4)
a.	$			$
b.	$			$
c.	$			$
d. TOTAL				$

C. TOTAL NON ENERGY DISCOUNTED SAVINGS (3A2+3Bd4)

4. SIMPLE PAYBACK 1G/(2N3+3A+(3Bd1/ECONOMIC LIFE)): 1.57 YEARS
5. TOTAL NET DISCOUNTED SAVINGS (2N5+3C): $7,542
6. SAVINGS TO INVESTMENT RATION (SIR) 5/1G: 7.52
7. ADJUSTED INTERNAL RATE OF RETURN (AIRR): 14.97%

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CONSTRUCTION COST ESTIMATE

PROJECT: Energy Savings Oppurtunity Survey	PREPARED: March 1994 SHEET 1 OF 2
LOCATION: Fort A.P. Hill, Virginia	CONTRACT NO.: DACA 31-89-C-0198
AE PROJECT NO.: 92008	ESTIMATOR: JS PRELIM:
AE: Engineering Applications Consultants, P.C.	CHECKED BY: VP FINAL: X

SUMMARY: Occupancy Sensors

ITEM	QUANTITY		MATERIAL		LABOR		TOTAL COST
	NO.	MEAS	UNIT	COST	UNIT	COST	
Building 1253							
Occupancy Sensors-Infrared Wall Switch	8	EA	77.00	616	7.00	56	672
SUB-TOTAL				616		56	672

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CONSTRUCTION COST ESTIMATE

CONSTRUCTION COST ESTIMATE	PREPARED: March 1994 SHEET OF
PROJECT: Energy Savings Oppurtunity Survey	SHEET 2 OF 2
	CONTRACT NO.: DACA 31-89-C-0198
LOCATION: Fort A.P. Hill, Virginia	
AE PROJECT NO.:	ESTIMATOR: JS PRELIM:
AE: Engineering Applications Consultants, P.C.	CHECKED BY: VP FINAL: X

SUMMARY: Occupancy Sensors

ITEM	QUANTITY		MATERIAL		LABOR		TOTAL COST
	NO.	MEAS	UNIT	COST	UNIT	COST	
SUBTOTAL PREVIOUS PAGE				616		56	672
MARK-UP ON LABOR SUB-TOTAL	21.0%			----		12	12 684
TAXES ON MATERIAL SUB-TOTAL	5.0%			31		----	31 715
OVERHEAD SUB-TOTAL	15.0%						107 822
PROFIT SUB-TOTAL	12.0%						99 920
PRIME MARK-UP ON SUB SUB-TOTAL							920
GRAND TOTAL							900

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ENERGY BUDGET <A>

Building : 1253-Occupancy Sensors 02-17-94
Site : FORT A.P. HILL, Virginia 6063092204
Prepared By : E.A.C., P.C. Burke, VA
Carrier Hourly Analysis Program

TABLE 1. ANNUAL LOADS

Component	(kBTU)	(kBTU/sqft)*
Cooling Loads *	148,372	29.680
Heating Loads *	16,016	3.204

TABLE 2. ENERGY BY SYSTEM COMPONENT

	Site Energy		Source Energy	
Component	(kBTU)	(kBTU/sqft)*	(kBTU)	(kBTU/sqft)*
Air System Fans	21,655	4.332	22,795	4.560
Cooling Plants	64,603	12.923	68,004	13.603
Heating Plants	14,310	2.863	15,064	3.013
Pumps	0	0.000	0	0.000
>> HVAC Total	100,569	20.118	105,862	21.177
Lights	94,597	18.923	99,576	19.919
Other Electric	42,504	8.503	44,741	8.950
Misc. Electric	0	0.000	0	0.000
Dom. Hot Water	11,985	2.398	12,616	2.524
>> Non-HVAC Total	149,087	29.823	156,933	31.393
>> GRAND TOTAL	249,655	49.941	262,795	52.570

* Notes:
1. Site energy is the actual energy consumed.
2. Source energy accounts for electrical generating inefficiencies. For this study:
   Electric generating efficiency = 95.0 %
3. Energy per unit floor area is based on the gross building floor area. For this building:
   Gross floor area = 4,999 sqft
   Conditioned floor area = 3,659 sqft
4. Annual cooling load is the sum of all cooling plant loads.
5. Annual heating load is the sum of all primary and auxiliary heating plant loads. It does not include the domestic water heating load.

Compact Fluorescent Lights

LIFE CYCLE COST ANALYSIS SUMMARY
WITH SYNERGISTIC EFFECTS

LOCATION: Fort A.P. Hill, Virginia REGION: 3 PROJECT NO.: DACA 31-89-C-0198
PROJECT TITLE: Fort A.P. Hill- Energy Engineering Analysis Program FISCAL YEAR: 1994
DISCRETE PORTION NAME: Compact Fluorescent Lights
ANALYSIS DATE: January 1994 ECONOMIC LIFE (YRS 15 PREPARER: JJS

1. INVESTMENT COSTS:

A. CONSTRUCTION COST	$	300	
B. SIOH	$	17	
C. DESIGN COST	$	18	
D. TOTAL COST (1A+1B+1C)	$	335	
E. SALVAGE VALUE OF EXISTING EQUIPMENT			
F. PUBLIC UTILITY COMPANY REBATE			
G. TOTAL INVESTMENT (1D-1E-1F)			$335

2. ENERGY SAVINGS (+)/COST(-):

DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS- Oct 1992

ENERGY SOURCE	COST $/MBTU(1)	SAVING(S) MBTU/YR(2)	ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELEC	$20.67	6.9	$ 143	11.77	$ 1,686
B. DIST	$5.69		$	13.83	$
C. RESID			$		$
D. NG			$		$
E. LPG	$7.76		$	15.34	$
F. COAL			$		$
G. SOLAR			$		$
H. GEOTH			$		$
I. BIOMA			$		$
J. REFUS			$		$
K. WIND			$		$
L. OTHER			$		$
M. DEMAND SAVINGS			$		$
N. TOTAL		7	$ 143		$ 1,686

3. NON ENERGY SAVINGS (+) OR COST (-):

A. ANNUAL RECURRING (+/-)
(1) DISCOUNT FACTOR (TABLE A)
(2) DISCOUNTED SAVINGS/COST (3A X 3A1)

B. NON RECURRING SAVINGS (+) OR COST (-)

ITEM	SAVINGS(+) COST(-)(1)	YEAR OF OCCUR. (2)	DISCOUNT FACTOR(3)	DISCOUNTED SAVINGS(+)COST(-)(4)
a.	$			$
b.	$			$
c.	$			$
d. TOTAL				$

C. TOTAL NON ENERGY DISCOUNTED SAVINGS (3A2+3Bd4)

4. SIMPLE PAYBACK 1G/(2N3+3A+(3Bd1/ECONOMIC LIFE)):	2.34 YEARS
5. TOTAL NET DISCOUNTED SAVINGS (2N5+3C):	$1,686
6. SAVINGS TO INVESTMENT RATION (SIR) 5/1G:	5.04
7. ADJUSTED INTERNAL RATE OF RETURN (AIRR):	11.84%

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CONSTRUCTION COST ESTIMATE	PREPARED: March 1994	SHEET 1 OF 2
PROJECT: Energy Savings Oppurtunity Survey	CONTRACT NO.: DACA 31-89-C-0198	
LOCATION: Fort A.P. Hill, Virginia		
AE PROJECT NO.: 92008	ESTIMATOR: JS	PRELIM:
AE: Engineering Applications Consultants, P.C.	CHECKED BY: VP	FINAL: X

SUMMARY: Install Compact Fluorescent Lights

ITEM	QUANTITY		MATERIAL		LABOR		TOTAL COST
	NO.	MEAS	UNIT	COST	UNIT	COST	
Building 1253							
Replace Incandescent Lighting W/Compact Fl							
15 Watt Compact Fl (LEL15)	4	EA	25.00	100	0.50	2	102
18 Watt Quad Fl. (LCFP18)	4	EA	23.00	92	0.50	2	94
SUB-TOTAL				192		4	196

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CONSTRUCTION COST ESTIMATE

PREPARED: March 1994

PROJECT: Energy Savings Oppurtunity Survey

CONTRACT NO.: DACA 31-89-C-0198

LOCATION: Fort A.P. Hill, Virginia
AE PROJECT NO.:
AE: Engineering Applications Consultants, P.C.

ESTIMATOR: JS
CHECKED BY: VP

PRELIM:
FINAL: X

SUMMARY: Install Compact Fluorescent Lights

ITEM	QUANTITY		MATERIAL		LABOR		TOTAL COST
	NO.	MEAS	UNIT	COST	UNIT	COST	
SUBTOTAL PREVIOUS PAGE				192		4	196
MARK-UP ON LABOR SUB-TOTAL	21.0%			—		1	1 197
TAXES ON MATERIAL SUB-TOTAL	5.0%			10		—	10 206
OVERHEAD SUB-TOTAL	15.0%						31 237
PROFIT SUB-TOTAL	12.0%						28 266
PRIME MARK-UP ON SUB SUB-TOTAL							266
GRAND TOTAL							300

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ENGINEERING ANALYSIS

Sheet ____ of ____

By: ____

Compact Fluor Lights in Restrooms

Project: Fort A. P. Hill ESOS

Date: 2-28-94

Contract No.: DACA 31-89-C-0198

EAC Project No.: 92008

Existing Cond: 2 - Ceiling Lights w/ 2-75W incandescent lamps

4-75 WATT INCANDESCENT LIGHTS AROUND/ ABOVE SINKS

Proposed: Replace 75W Ceiling Lights with 18 WATT QUAD Style COMPACT FLUORESCENT Lights

Replace 75W INCANDESCENT LIGHTS ABOVE SINKS With 15W QUAD STYLE COMPACT FLUORESCENT LIGHTS

WATT SAVINGS = 354W

Ref: ECOLOGICAL INNOVATIONS CATALOG - 1-800-876-0660

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ENERGY BUDGET <A>

Building : #1253 - FORT A.P. HILL 02-17-94
Site : FORT A.P. HILL, Virginia 6063092204
Prepared By : E.A.C., P.C. Burke, VA
Carrier Hourly Analysis Program

TABLE 1. ANNUAL LOADS

Component	(kBTU)	(kBTU/sqft)*
Cooling Loads *	164,608	32.922
Heating Loads *	11,793	2.359

TABLE 2. ENERGY BY SYSTEM COMPONENT

Component	<----- Site Energy -----> (kBTU)	(kBTU/sqft)*	<---- Source Energy ----> (kBTU)	(kBTU/sqft)*
Air System Fans	23,900	4.780	25,158	5.032
Cooling Plants	71,456	14.291	75,217	15.043
Heating Plants	10,760	2.152	11,327	2.265
Pumps	0	0.000	0	0.000
>> HVAC Total	106,117	21.223	111,702	22.340
Lights	113,618	22.724	119,597	23.919
Other Electric	42,081	8.416	44,295	8.859
Misc. Electric	0	0.000	0	0.000
Dom. Hot Water	11,985	2.397	12,616	2.523
>> Non-HVAC Total	167,684	33.537	176,509	35.302
>> GRAND TOTAL	273,800	54.760	288,211	57.642

* Notes:
1. Site energy is the actual energy consumed.
2. Source energy accounts for electrical generating inefficiencies. For this study:
   Electric generating efficiency = 95.0 %
3. Energy per unit floor area is based on the gross building floor area. For this building:
   Gross floor area = 5,000 sqft
   Conditioned floor area = 3,660 sqft
4. Annual cooling load is the sum of all cooling plant loads.
5. Annual heating load is the sum of all primary and auxiliary heating plant loads. It does not include the domestic water heating load.

Energy Savings Fluorescent Lamps

LIFE CYCLE COST ANALYSIS SUMMARY
WITH SYNERGISTIC EFFECTS

LOCATION: Fort A.P. Hill, Virginia — REGION: 3 — PROJECT NO.: DACA 31-89-C-0198
PROJECT TITLE: Fort A.P. Hill- Energy Engineering Analysis Program — FISCAL YEAR: 1994
DISCRETE PORTION NAME: Energy Savings Fluorescent Lamps
ANALYSIS DATE: January 1994 — ECONOMIC LIFE (YRS 15 — PREPARER: JJS

1. INVESTMENT COSTS:

A. CONSTRUCTION COST	$	1,000	
B. SIOH	$	55	
C. DESIGN COST	$	60	
D. TOTAL COST (1A+1B+1C)	$	1,115	
E. SALVAGE VALUE OF EXISTING EQUIPMENT			
F. PUBLIC UTILITY COMPANY REBATE			
G. TOTAL INVESTMENT (1D-1E-1F)			$1,115

2. ENERGY SAVINGS (+)/COST(-):

DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS- Oct 1992

ENERGY SOURCE	COST \$/MBTU(1)	SAVING(S) MBTU/YR(2)	ANNUAL \$ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELEC	$20.67	22.8	$ 471	11.77	$ 5,547
B. DIST	$5.69		$	13.83	$
C. RESID			$		$
D. NG			$		$
E. LPG	$7.76		$	15.34	$
F. COAL			$		$
G. SOLAR			$		$
H. GEOTH			$		$
I. BIOMA			$		$
J. REFUS			$		$
K. WIND			$		$
L. OTHER			$		$
M. DEMAND SAVINGS			$		$
N. TOTAL		23	$ 471		$ 5,547

3. NON ENERGY SAVINGS (+) OR COST (-):

A. ANNUAL RECURRING (+/-)
(1) DISCOUNT FACTOR (TABLE A)
(2) DISCOUNTED SAVINGS/COST (3A X 3A1)

B. NON RECURRING SAVINGS (+) OR COST (-)

ITEM	SAVINGS(+) COST(-)(1)	YEAR OF OCCUR. (2)	DISCOUNT FACTOR(3)	DISCOUNTED SAVINGS(+)COST(-)(4)
a.	$			$
b.	$			$
c.	$			$
d. TOTAL				$

C. TOTAL NON ENERGY DISCOUNTED SAVINGS (3A2+3Bd4)

4. SIMPLE PAYBACK 1G/(2N3+3A+(3Bd1/ECONOMIC LIFE)):	2.37 YEARS
5. TOTAL NET DISCOUNTED SAVINGS (2N5+3C):	$5,547
6. SAVINGS TO INVESTMENT RATION (SIR) 5/1G:	4.97
7. ADJUSTED INTERNAL RATE OF RETURN (AIRR):	11.74%

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CONSTRUCTION COST ESTIMATE

PREPARED: March 1994

PROJECT: Energy Savings Oppurtunity Survey

CONTRACT NO.: DACA 31-89-C-0198

LOCATION: Fort A.P. Hill, Virginia
AE PROJECT NO.: 92008
AE: Engineering Applications Consultants, P.C.

ESTIMATOR: JS
CHECKED BY: VP

PRELIM:
FINAL: X

SUMMARY: Energy Saving Fluor. Lamps

ITEM	QUANTITY		MATERIAL		LABOR		TOTAL
	NO.	MEAS	UNIT	COST	UNIT	COST	COST
Building 1253 Install 35 Watt Energy Saving Fluor. Lamps	144	EA	3.45	497	1.50	216	713
SUB-TOTAL				497		216	713

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CONSTRUCTION COST ESTIMATE	PREPARED: March 1994	SHEET 2 OF 2
PROJECT: Energy Savings Oppurtunity Survey	CONTRACT NO.: DACA 31-89-C-0198	
LOCATION: Fort A.P. Hill, Virginia		
AE PROJECT NO.:	ESTIMATOR: JS	PRELIM:
AE: Engineering Applications Consultants, P.C.	CHECKED BY: VP	FINAL: X

SUMMARY: Energy Saving Fluor. Lamps

ITEM	QUANTITY NO.	QUANTITY MEAS	MATERIAL UNIT	MATERIAL COST	LABOR UNIT	LABOR COST	TOTAL COST
SUBTOTAL PREVIOUS PAGE				497		216	713
MARK-UP ON LABOR SUB-TOTAL	21.0%			—		45	45 758
TAXES ON MATERIAL SUB-TOTAL	5.0%			25		—	25 783
OVERHEAD SUB-TOTAL	15.0%						117 901
PROFIT SUB-TOTAL	12.0%						108 1,009
PRIME MARK-UP ON SUB SUB-TOTAL							1,009
GRAND TOTAL							1,000

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ENERGY BUDGET <A>

Building : 1253-34W En.Sav w/syn. 02-17-94
Site : FORT A.P. HILL, Virginia 6063092204
Prepared By : E.A.C., P.C. Burke, VA
Carrier Hourly Analysis Program

TABLE 1. ANNUAL LOADS

Component	(kBTU)	(kBTU/sqft)*
Cooling Loads *	135,602	27.126
Heating Loads *	16,927	3.386

TABLE 2. ENERGY BY SYSTEM COMPONENT

	<----- Site Energy ----->		<---- Source Energy ---->	
Component	(kBTU)	(kBTU/sqft)*	(kBTU)	(kBTU/sqft)*
Air System Fans	19,935	3.988	20,984	4.198
Cooling Plants	59,290	11.860	62,411	12.485
Heating Plants	11,646	2.330	12,259	2.452
Pumps	0	0.000	0	0.000
>> HVAC Total	90,871	18.178	95,654	19.135
Lights	81,518	16.307	85,808	17.165
Other Electric	42,504	8.503	44,741	8.950
Misc. Electric	0	0.000	0	0.000
Dom. Hot Water	11,985	2.398	12,616	2.524
>> Non-HVAC Total	136,008	27.207	143,166	28.639
>> GRAND TOTAL	226,879	45.385	238,820	47.773

* Notes:
1. Site energy is the actual energy consumed.
2. Source energy accounts for electrical generating inefficiencies. For this study:
   Electric generating efficiency = 95.0 %
3. Energy per unit floor area is based on the gross building floor area. For this building:
   Gross floor area = 4,999 sqft
   Conditioned floor area = 3,659 sqft
4. Annual cooling load is the sum of all cooling plant loads.
5. Annual heating load is the sum of all primary and auxiliary heating plant loads. It does not include the domestic water heating load.

Exit Sign Retrofit

LIFE CYCLE COST ANALYSIS SUMMARY
WITH SYNERGISTIC EFFECTS

LOCATION: Fort A.P. Hill, Virginia — REGION: 3 — PROJECT NO.: DACA 31-89-C-0198
PROJECT TITLE: Fort A.P. Hill- Energy Engineering Analysis Program — FISCAL YEAR: 1994
DISCRETE PORTION NAME: Exit Sign Retrofit
ANALYSIS DATE: January 1994 — ECONOMIC LIFE (YRS 15 — PREPARER: JJS

1. INVESTMENT COSTS:

A. CONSTRUCTION COST	$	800	
B. SIOH	$	44	
C. DESIGN COST	$	48	
D. TOTAL COST (1A+1B+1C)	$	892	
E. SALVAGE VALUE OF EXISTING EQUIPMENT			
F. PUBLIC UTILITY COMPANY REBATE			
G. TOTAL INVESTMENT (1D-1E-1F)			$892

2. ENERGY SAVINGS (+)/COST(-):

DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS- Oct 1992

ENERGY SOURCE	COST $/MBTU(1)	SAVING(S) MBTU/YR(2)	ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELEC	$20.67	5.4	$ 111	11.77	$ 1,309
B. DIST	$5.69		$	13.83	$
C. RESID			$		$
D. NG			$		$
E. LPG	$7.76		$	15.34	$
F. COAL			$		$
G. SOLAR			$		$
H. GEOTH			$		$
I. BIOMA			$		$
J. REFUS			$		$
K. WIND			$		$
L. OTHER			$		$
M. DEMAND SAVINGS			$		$
N. TOTAL		5	$ 111		$ 1,309

3. NON ENERGY SAVINGS (+) OR COST (-):

A. ANNUAL RECURRING (+/-)
(1) DISCOUNT FACTOR (TABLE A)
(2) DISCOUNTED SAVINGS/COST (3A X 3A1)

B. NON RECURRING SAVINGS (+) OR COST (-)

ITEM	SAVINGS(+) COST(-)(1)	YEAR OF OCCUR. (2)	DISCOUNT FACTOR(3)	DISCOUNTED SAVINGS(+)COST(-)(4)
a.	$			$
b.	$			$
c.	$			$
d. TOTAL				$

C. TOTAL NON ENERGY DISCOUNTED SAVINGS (3A2+3Bd4)

4. SIMPLE PAYBACK 1G/(2N3+3A+(3Bd1/ECONOMIC LIFE)): 8.02 YEARS
5. TOTAL NET DISCOUNTED SAVINGS (2N5+3C): $1,309
6. SAVINGS TO INVESTMENT RATION (SIR) 5/1G: 1.47
7. ADJUSTED INTERNAL RATE OF RETURN (AIRR): 2.69%

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CONSTRUCTION COST ESTIMATE	PREPARED: March 1994 SHEET 1 OF 2
PROJECT: Energy Savings Oppurtunity Survey	CONTRACT NO.: DACA 31-89-C-0198
LOCATION: Fort A.P. Hill, Virginia	
AE PROJECT NO.: 92008	ESTIMATOR: JS PRELIM:
AE: Engineering Applications Consultants, P.C.	CHECKED BY: VP FINAL: X

SUMMARY: Exit Sign Retrofit

ITEM	QUANTITY		MATERIAL		LABOR		TOTAL
	NO.	MEAS	UNIT	COST	UNIT	COST	COST
Building 1253 Battery Backup LED Exit Sign Replacement Fixtures	4	EA	125.00	500	25.00	100	600
SUB-TOTAL				500		100	600

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CONSTRUCTION COST ESTIMATE

PREPARED: March 1994 SHEET 2 OF 2

PROJECT: Energy Savings Oppurtunity Survey

CONTRACT NO.: DACA 31-89-C-0198

LOCATION: Fort A.P. Hill, Virginia
AE PROJECT NO.:
AE: Engineering Applications Consultants, P.C.

ESTIMATOR: JS PRELIM:
CHECKED BY: VP FINAL: X

SUMMARY: Exit Sign Retrofit

ITEM	QUANTITY NO.	QUANTITY MEAS	MATERIAL UNIT	MATERIAL COST	LABOR UNIT	LABOR COST	TOTAL COST
SUBTOTAL PREVIOUS PAGE				500		100	600
MARK-UP ON LABOR SUB-TOTAL	21.0%			---		21	21 621
TAXES ON MATERIAL SUB-TOTAL	5.0%			25		---	25 646
OVERHEAD SUB-TOTAL	15.0%						97 743
PROFIT SUB-TOTAL	12.0%						89 832
PRIME MARK-UP ON SUB SUB-TOTAL							 832
GRAND TOTAL							800

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LIGHTING CALCULATION WORKSHEET CLIENT: FORT A.P HILL BUILDING: 1253

Type of Lamp	# of Lamps	x	Watts/ Lamp	x	Ballast Usage	/ 1000 =	KW	x	Hours/ Week	x	Weeks/ Month	x	Months/ Year	=	KWH/Year	x	$/KWH	=	$/Year	
INCAN.	8	x	25	x	1	/ 1000 =	.2	x	168	x	4.345	x	12	=	1752	x	.063	=	$ 110	Standard
LED	4	x	6	x	1.2	/ 1000 =	.02	x	168	x	4.345	x	12	=	175	x	.063	=	$ 11	Replacement

REPLACE EXIT SIGNS WITH LED EXIT SIGN

LABOR = 1HR @ $25/HR

Energy Savings = 1577 KWH = $ 99

Demand Savings = ____ KW x ____ mo/yr = ____ KW x $____ /KW = $____

Cost = $ 100 x ____ = $____ Payback = ____ years

---

		x		x		/ 1000 =		x		x	4.345	x		=		x		=	$	Standard
		x		x		/ 1000 =		x		x	4.345	x		=		x		=	$	Replacement

Energy Savings = ____ KWH = $____

Demand Savings = ____ KW x ____ mo/yr = ____ KW x $____ /KW = $____

Cost = $____ x ____ = $____ Payback = ____ years

---

		x		x		/ 1000 =		x		x	4.345	x		=		x		=	$	Standard
		x		x		/ 1000 =		x		x	4.345	x		=		x		=	$	Replacement

Energy Savings = ____ KWH = $____

Demand Savings = ____ KW x ____ mo/yr = ____ KW x $____ /KW = $____

Cost = $____ x ____ = $____ Payback = ____ years

---

		x		x		/ 1000 =		x		x	4.345	x		=		x		=	$	Standard
		x		x		/ 1000 =		x		x	4.345	x		=		x		=	$	Replacement

Energy Savings = ____ KWH = $____

Demand Savings = ____ KW x ____ mo/yr = ____ KW x $____ /KW = $____

Cost = $____ x ____ = $____ Payback = ____ years

Replace Exiting Fluorescent Fixtures with Energy Effiecient Fixtures, Ballast and Lamps

LIFE CYCLE COST ANALYSIS SUMMARY
WITH SYNERGISTIC EFFECTS

LOCATION: Fort A.P. Hill, Virginia REGION: 3 PROJECT NO.: DACA 31-89-C-0198
PROJECT TITLE: Fort A.P. Hill- Energy Engineering Analysis Program FISCAL YEAR: 1994
DISCRETE PORTION NAME: Replace Existing Fluorescent Fixtures with Energy Efficient Fixtures, Ballast and Lamps
ANALYSIS DATE: January 1994 ECONOMIC LIFE (YR 15 PREPARER: JJS

1. INVESTMENT COSTS:

A. CONSTRUCTION COST	$	4,080	
B. SIOH	$	224	
C. DESIGN COST	$	245	
D. TOTAL COST (1A+1B+1C)	$	4,549	
E. SALVAGE VALUE OF EXISTING EQUIPMENT			
F. PUBLIC UTILITY COMPANY REBATE			
G. TOTAL INVESTMENT (1D-1E-1F)			$4,549

2. ENERGY SAVINGS (+)/COST(-):

DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS- Oct 1992

ENERGY SOURCE	COST $/MBTU(1)	SAVING(S) MBTU/YR(2)	ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELEC	$20.67	39.7	$ 821	11.77	$ 9,658
B. DIST	$5.69		$	13.83	$
C. RESID			$		$
D. NG			$		$
E. LPG	$7.76		$	15.34	$
F. COAL			$		$
G. SOLAR			$		$
H. GEOTH			$		$
I. BIOMA			$		$
J. REFUS			$		$
K. WIND			$		$
L. OTHER			$		$
M. DEMAND SAVINGS			$		$
N. TOTAL		40	$ 821		$ 9,658

3. NON ENERGY SAVINGS (+) OR COST (-):

A. ANNUAL RECURRING (+/-)
(1) DISCOUNT FACTOR (TABLE A)
(2) DISCOUNTED SAVINGS/COST (3A X 3A1)

B. NON RECURRING SAVINGS (+) OR COST (-)

ITEM	SAVINGS(+) COST(-)(1)	YEAR OF OCCUR. (2)	DISCOUNT FACTOR(3)	DISCOUNTED SAVINGS(+)COST(-)(4)
a.	$			$
b.	$			$
c.	$			$
d. TOTAL				$

C. TOTAL NON ENERGY DISCOUNTED SAVINGS (3A2+3Bd4)

4. SIMPLE PAYBACK 1G/(2N3+3A+(3Bd1/ECONOMIC LIFE)): 5.54 YEARS
5. TOTAL NET DISCOUNTED SAVINGS (2N5+3C): $9,658
6. SAVINGS TO INVESTMENT RATION (SIR) 5/1G: 2.12
7. ADJUSTED INTERNAL RATE OF RETURN (AIRR): 5.35%

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CONSTRUCTION COST ESTIMATE

PREPARED: March 1994 SHEET 1 OF 2

PROJECT: Energy Savings Oppurtunity Survey

CONTRACT NO.: DACA 31-89-C-0198

LOCATION: Fort A.P. Hill, Virginia
AE PROJECT NO.: 92008
AE: Engineering Applications Consultants, P.C.

ESTIMATOR: JS PRELIM:
CHECKED BY: VP FINAL: X

SUMMARY: Replace Existing Fluorescent Fixtures with Energy Efficient Fixtures, Ballast and Lamps

ITEM	QUANTITY		MATERIAL		LABOR		TOTAL COST
	NO.	MEAS	UNIT	COST	UNIT	COST	
Building 1253							
F32T-8 Lighting Retrofit							
Two Lamp Fixtures Ballast-	3	EA	27.00	81	16.00	48	129
Four Lamp Fixtures Ballast-	50	EA	32.00	1,600	8.00	400	2,000
F32T-8 Lamps	106	EA	6.00	636	1.50	159	795
SUB-TOTAL				2,317		607	2,924

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CONSTRUCTION COST ESTIMATE	PREPARED: March 1994 SHEET OF
PROJECT: Energy Savings Oppurtunity Survey	SHEET 2 OF 2 CONTRACT NO.: DACA 31-89-C-0198
LOCATION: Fort A.P. Hill, Virginia AE PROJECT NO.: AE: Engineering Applications Consultants, P.C.	ESTIMATOR: JS PRELIM: CHECKED BY: VP FINAL: X

SUMMARY: Replace Existing Fluorescent Fixtures with Energy Efficient Fixtures, Ballast and Lamps

ITEM	QUANTITY		MATERIAL		LABOR		TOTAL COST
	NO.	MEAS	UNIT	COST	UNIT	COST	
SUBTOTAL PREVIOUS PAGE				2,317		607	2,924
MARK-UP ON LABOR SUB-TOTAL	21.0%			—		127	127 3,051
TAXES ON MATERIAL SUB-TOTAL	5.0%			116		—	116 3,167
OVERHEAD SUB-TOTAL	15.0%						475 3,642
PROFIT SUB-TOTAL	12.0%						437 4,080
PRIME MARK-UP ON SUB SUB-TOTAL							4,080
GRAND TOTAL							4,100

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Engineering
Applications
Consultants

A Professional
Corporation

9004-B Crownwood Ct.
Burke, Virginia 22015-1630
(703) 978-0923

ENGINEERING ANALYSIS

Sheet ____ of ____

By: JS

T-8 REPLACEMENT LAMPS

Project: Fort A. P. Hill ESOS Date: 2-28-94

Contract No.: DACA 31-89-C-0198 EAC Project No.: 92008

Replace F40 T12 with F32T-8

Re-use Fixture Housing.

- Replace exist Ballast with electronic T-8 Ballast (2 Lamps per ball.

COST FOR ELECTRONIC BALLAST:

	MAT	LABOR
4 LAMP FIXTURE	$32.00	$8
2 LAMP FIXTURE	$27.00	$6
F32 T-8 LAMPS	$6.00/LAMP	1.50

REF: STEVE Rolfe, ENVIRONMENTAL Lighting
ALEXANDRIA, VA
(703) 820-3397
2/15/94

ENERGY BUDGET <A>

Building : #1253-T-8 Lights w/Syn. 02-17-94
Site : FORT A.P. HILL, Virginia 6063092204
Prepared By : E.A.C., P.C. Burke, VA
Carrier Hourly Analysis Program

TABLE 1. ANNUAL LOADS

Component	(kBTU)	(kBTU/sqft)*
Cooling Loads *	124,585	24.922
Heating Loads *	18,156	3.632

TABLE 2. ENERGY BY SYSTEM COMPONENT

Component	<----- Site Energy -----> (kBTU)	(kBTU/sqft)*	<---- Source Energy ----> (kBTU)	(kBTU/sqft)*
Air System Fans	18,548	3.710	19,525	3.906
Cooling Plants	54,655	10.933	57,532	11.509
Heating Plants	12,380	2.476	13,032	2.607
Pumps	0	0.000	0	0.000
>> HVAC Total	85,584	17.120	90,088	18.021
Lights	69,894	13.982	73,573	14.718
Other Electric	42,504	8.503	44,741	8.950
Misc. Electric	0	0.000	0	0.000
Dom. Hot Water	11,985	2.398	12,616	2.524
>> Non-HVAC Total	124,384	24.882	130,931	26.191
>> GRAND TOTAL	209,968	42.002	221,019	44.213

* Notes:
1. Site energy is the actual energy consumed.
2. Source energy accounts for electrical generating inefficiencies. For this study:
   Electric generating efficiency = 95.0 %
3. Energy per unit floor area is based on the gross building floor area. For this building:
   Gross floor area = 4,999 sqft
   Conditioned floor area = 3,659 sqft
4. Annual cooling load is the sum of all cooling plant loads.
5. Annual heating load is the sum of all primary and auxiliary heating plant loads. It does not include the domestic water heating load.

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Economizer Controls

LIFE CYCLE COST ANALYSIS SUMMARY
WITH SYNERGISTIC EFFECTS

LOCATION: Fort A.P. Hill, Virginia — REGION: 3 — PROJECT NO.: DACA 31-89-C-0198
PROJECT TITLE: Fort A.P. Hill- Energy Engineering Analysis Program — FISCAL YEAR: 1994
DISCRETE PORTION NAME: Economizer Controls
ANALYSIS DATE: January 1994 — ECONOMIC LIFE (YRS 10 — PREPARER: JJS

1. INVESTMENT COSTS:

A. CONSTRUCTION COST	$ 5,000		
B. SIOH	$ 275		
C. DESIGN COST	$ 300		
D. TOTAL COST (1A+1B+1C)	$ 5,575		
E. SALVAGE VALUE OF EXISTING EQUIPMENT			
F. PUBLIC UTILITY COMPANY REBATE			
G. TOTAL INVESTMENT (1D-1E-1F)			$5,575

2. ENERGY SAVINGS (+)/COST(-):

DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS- Oct 1992

ENERGY SOURCE	COST \$/MBTU(1)	SAVING(S) MBTU/YR(2)	ANNUAL \$ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELEC	$20.67	24.0	$ 496	8.39	$ 4,162
B. DIST	$5.69		$	9.48	$
C. RESID			$		$
D. NG			$		$
E. LPG	$7.76		$	15.34	$
F. COAL			$		$
G. SOLAR			$		$
H. GEOTH			$		$
I. BIOMA			$		$
J. REFUS			$		$
K. WIND			$		$
L. OTHER			$		$
M. DEMAND SAVINGS			$		$
N. TOTAL		24	$ 496		$ 4,162

3. NON ENERGY SAVINGS (+) OR COST (-):

A. ANNUAL RECURRING (+/-)
(1) DISCOUNT FACTOR (TABLE A)
(2) DISCOUNTED SAVINGS/COST (3A X 3A1)

B. NON RECURRING SAVINGS (+) OR COST (-)

ITEM	SAVINGS(+) COST(-)(1)	YEAR OF OCCUR. (2)	DISCOUNT FACTOR(3)	DISCOUNTED SAV-INGS(+)COST(-)(4)
a.	$			$
b.	$			$
c.	$			$
d. TOTAL				$

C. TOTAL NON ENERGY DISCOUNTED SAVINGS (3A2+3Bd4)

4. SIMPLE PAYBACK 1G/(2N3+3A+(3Bd1/ECONOMIC LIFE)):	11.24 YEARS
5. TOTAL NET DISCOUNTED SAVINGS (2N5+3C):	$4,162
6. SAVINGS TO INVESTMENT RATION (SIR) 5/1G:	0.75
7. ADJUSTED INTERNAL RATE OF RETURN (AIRR):	-3.00%

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CONSTRUCTION COST ESTIMATE

PREPARED: March 1994

PROJECT: Energy Savings Oppurtunity Survey

CONTRACT NO.: DACA 31-89-C-0198

LOCATION: Fort A.P. Hill, Virginia
AE PROJECT NO.: 92008
AE: Engineering Applications Consultants, P.C.

ESTIMATOR: JS
CHECKED BY: VP

PRELIM:
FINAL: X

SUMMARY: Economizer Controls

ITEM	QUANTITY		MATERIAL		LABOR		TOTAL COST
	NO.	MEAS	UNIT	COST	UNIT	COST	
Building 1253							
Ductwork	125	LBS	0.48	60	2.18	273	333
24x24 O.A. Louver	4	SF	35.00	140	7.35	29	169
28x8 Dampers	4	EA	147.00	588	34.00	136	724
Economizer Control Package	2	EA	75.00	150	50.00	100	250
Enthalpy Sensor	1	EA	95.00	95	30.00	30	125
2450 cfm Exhaust Fan	1	EA	275.00	275	150.00	150	425
Control Wiring	125	LF	0.17	21	0.42	53	74
Damper Motor Actuator	2	EA	250.00	500	26.00	52	552
24x24 Return Registers	3	EA	65.00	195	18.75	56	251
Motor Starter in Nema One Enclosure	1	EA	150.00	150	130.00	130	280
3/4" Conduit (EMT)	150	LF	0.50	75	1.61	242	317
#12 THHN Wiring	150	LF	0.059	9	0.19	29	38
SUB-TOTAL				2,258		1,280	3,538

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CONSTRUCTION COST ESTIMATE	PREPARED: March 1994	SHEET OF
PROJECT: Energy Savings Oppurtunity Survey	CONTRACT NO.: DACA 31-89-C-0198	SHEET 2 OF 2
LOCATION: Fort A.P. Hill, Virginia		
AE PROJECT NO.:	ESTIMATOR: JS	PRELIM:
AE: Engineering Applications Consultants, P.C.	CHECKED BY: VP	FINAL: X

SUMMARY:

ITEM	QUANTITY		MATERIAL		LABOR		TOTAL
	NO.	MEAS	UNIT	COST	UNIT	COST	COST
SUBTOTAL PREVIOUS PAGE				2,258		1,280	3,538
MARK-UP ON LABOR SUB-TOTAL	21.0%			—		269	269 3,807
TAXES ON MATERIAL SUB-TOTAL	5.0%			113		—	113 3,920
OVERHEAD SUB-TOTAL	15.0%						588 4,508
PROFIT SUB-TOTAL	12.0%						541 5,049
PRIME MARK-UP ON SUB SUB-TOTAL							5,049
GRAND TOTAL							5,000

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ENERGY BUDGET <A>

Building : 1253- Economizer Control 02-17-94
Site : FORT A.P. HILL, Virginia 6063092204
Prepared By : E.A.C., P.C. Burke, VA
Carrier Hourly Analysis Program

TABLE 1. ANNUAL LOADS

Component	(kBTU)	(kBTU/sqft)*
Cooling Loads *	112,380	22.476
Heating Loads *	13,832	2.766

TABLE 2. ENERGY BY SYSTEM COMPONENT

Component	<----- Site Energy -----> (kBTU)	(kBTU/sqft)*	<---- Source Energy ----> (kBTU)	(kBTU/sqft)*
Air System Fans	17,673	3.535	18,603	3.721
Cooling Plants	48,570	9.714	51,126	10.225
Heating Plants	12,336	2.467	12,985	2.597
Pumps	0	0.000	0	0.000
>> HVAC Total	78,579	15.716	82,715	16.543
Lights	113,618	22.724	119,597	23.919
Other Electric	42,081	8.416	44,295	8.859
Misc. Electric	0	0.000	0	0.000
Dom. Hot Water	11,985	2.397	12,616	2.523
>> Non-HVAC Total	167,684	33.537	176,509	35.302
>> GRAND TOTAL	246,263	49.253	259,224	51.845

* Notes:
1. Site energy is the actual energy consumed.
2. Source energy accounts for electrical generating inefficiencies. For this study:
   Electric generating efficiency = 95.0 %
3. Energy per unit floor area is based on the gross building floor area. For this building:
   Gross floor area = 5,000 sqft
   Conditioned floor area = 3,660 sqft
4. Annual cooling load is the sum of all cooling plant loads.
5. Annual heating load is the sum of all primary and auxiliary heating plant loads. It does not include the domestic water heating load.

LHR

Daylight Dimming Controls

LIFE CYCLE COST ANALYSIS SUMMARY
WITH SYNERGISTIC EFFECTS

LOCATION: Fort A.P. Hill, Virginia REGION: 3 PROJECT NO.: DACA 31-89-C-0198
PROJECT TITLE: Fort A.P. Hill- Energy Engineering Analysis Program FISCAL YEAR: 1994
DISCRETE PORTION NAME: Daylight Dimming Controls
ANALYSIS DATE: January 1994 ECONOMIC LIFE (YRS 15 PREPARER: JJS

1. INVESTMENT COSTS:

A. CONSTRUCTION COST	$	1,600	
B. SIOH	$	88	
C. DESIGN COST	$	96	
D. TOTAL COST (1A+1B+1C)	$	1,784	
E. SALVAGE VALUE OF EXISTING EQUIPMENT			
F. PUBLIC UTILITY COMPANY REBATE			
G. TOTAL INVESTMENT (1D-1E-1F)			$1,784

2. ENERGY SAVINGS (+)/COST(-):

DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS- Oct 1992

ENERGY SOURCE	COST $/MBTU(1)	SAVING(S) MBTU/YR(2)	ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELEC	$20.67	6.2	$ 128	11.77	$ 1,508
B. DIST	$5.69		$	13.83	$
C. RESID			$		$
D. NG			$		$
E. LPG	$7.76		$	15.34	$
F. COAL			$		$
G. SOLAR			$		$
H. GEOTH			$		$
I. BIOMA			$		$
J. REFUS			$		$
K. WIND			$		$
L. OTHER			$		$
M. DEMAND SAVINGS			$		$
N. TOTAL		6	$ 128		$ 1,508

3. NON ENERGY SAVINGS (+) OR COST (-):

A. ANNUAL RECURRING (+/-)
(1) DISCOUNT FACTOR (TABLE A)
(2) DISCOUNTED SAVINGS/COST (3A X 3A1)

B. NON RECURRING SAVINGS (+) OR COST (-)

ITEM	SAVINGS(+) COST(-)(1)	YEAR OF OCCUR. (2)	DISCOUNT FACTOR(3)	DISCOUNTED SAV-INGS(+)COST(-)(4)
a.	$			$
b.	$			$
c.	$			$
d. TOTAL				$

C. TOTAL NON ENERGY DISCOUNTED SAVINGS (3A2+3Bd4)

4. SIMPLE PAYBACK 1G/(2N3+3A+(3Bd1/ECONOMIC LIFE)):	13.92 YEARS
5. TOTAL NET DISCOUNTED SAVINGS (2N5+3C):	$1,508
6. SAVINGS TO INVESTMENT RATION (SIR) 5/1G:	0.85
7. ADJUSTED INTERNAL RATE OF RETURN (AIRR):	-1.16%

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CONSTRUCTION COST ESTIMATE	PREPARED: March 1994	SHEET 1 OF 2
PROJECT: Energy Savings Oppurtunity Survey	CONTRACT NO.: DACA 31-89-C-0198	
LOCATION: Fort A.P. Hill, Virginia		
AE PROJECT NO.: 92008	ESTIMATOR: JS	PRELIM:
AE: Engineering Applications Consultants, P.C.	CHECKED BY: VP	FINAL: X

SUMMARY: Daylighting Dimming Controls

ITEM	QUANTITY		MATERIAL		LABOR		TOTAL
	NO.	MEAS	UNIT	COST	UNIT	COST	COST
Building 1253							
Daylight Dimming Controls	4	EA	180.00	720	100.00	400	1,120
SUB-TOTAL				720		400	1,120

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CONSTRUCTION COST ESTIMATE	PREPARED: March 1994 SHEET OF
PROJECT: Energy Savings Oppurtunity Survey	SHEET 2 OF 2
LOCATION: Fort A.P. Hill, Virginia	CONTRACT NO.: DACA 31-89-C-0198
AE PROJECT NO.:	ESTIMATOR: JS PRELIM:
AE: Engineering Applications Consultants, P.C.	CHECKED BY: VP FINAL: X

SUMMARY: Daylighting Dimming Controls

ITEM	QUANTITY		MATERIAL		LABOR		TOTAL COST
	NO.	MEAS	UNIT	COST	UNIT	COST	
SUBTOTAL PREVIOUS PAGE				720		400	1,120
MARK-UP ON LABOR SUB-TOTAL	21.0%			—		84	84 1,204
TAXES ON MATERIAL SUB-TOTAL	5.0%			36		—	36 1,240
OVERHEAD SUB-TOTAL	15.0%						186 1,426
PROFIT SUB-TOTAL	12.0%						171 1,597
PRIME MARK-UP ON SUB SUB-TOTAL							1,597
GRAND TOTAL							1,600

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ENERGY BUDGET <A>

Building : 1253-Daylight Dimming 02-17-94
Site : FORT A.P. HILL, Virginia 6063092204
Prepared By : E.A.C., P.C. Burke, VA
Carrier Hourly Analysis Program

TABLE 1. ANNUAL LOADS

Component	(kBTU)	(kBTU/sqft)*
Cooling Loads *	120,498	24.104
Heating Loads *	18,275	3.656

TABLE 2. ENERGY BY SYSTEM COMPONENT

Component	Site Energy (kBTU)	Site Energy (kBTU/sqft)*	Source Energy (kBTU)	Source Energy (kBTU/sqft)*
Air System Fans	17,863	3.573	18,803	3.761
Cooling Plants	52,948	10.592	55,734	11.149
Heating Plants	12,409	2.482	13,062	2.613
Pumps	0	0.000	0	0.000
>> HVAC Total	83,220	16.647	87,600	17.524
Lights	66,124	13.227	69,604	13.924
Other Electric	42,504	8.503	44,741	8.950
Misc. Electric	0	0.000	0	0.000
Dom. Hot Water	11,985	2.398	12,616	2.524
>> Non-HVAC Total	120,614	24.128	126,962	25.397
>> GRAND TOTAL	203,834	40.775	214,562	42.921

* Notes:
1. Site energy is the actual energy consumed.
2. Source energy accounts for electrical generating inefficiencies. For this study:
   Electric generating efficiency = 95.0 %
3. Energy per unit floor area is based on the gross building floor area. For this building:
   Gross floor area = 4,999 sqft
   Conditioned floor area = 3,659 sqft
4. Annual cooling load is the sum of all cooling plant loads.
5. Annual heating load is the sum of all primary and auxiliary heating plant loads. It does not include the domestic water heating load.

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Shut Down Energy to Hotwater Heaters or Modify Controls

LIFE CYCLE COST ANALYSIS SUMMARY
WITH SYNERGISTIC EFFECTS

LOCATION: Fort A.P. Hill, Virginia REGION: 3 PROJECT NO.: DACA 31-89-C-0198
PROJECT TITLE: Fort A.P. Hill- Energy Engineering Analysis Program FISCAL YEAR: 1994
DISCRETE PORTION NAME: Shut Down Energy to Hotwater Heaters or Modify Controls
ANALYSIS DATE: January 1994 ECONOMIC LIFE (YRS 20 PREPARER: JJS

1. INVESTMENT COSTS:

A. CONSTRUCTION COST	$	85	
B. SIOH	$	5	
C. DESIGN COST	$	5	
D. TOTAL COST (1A+1B+1C)	$	95	
E. SALVAGE VALUE OF EXISTING EQUIPMENT			
F. PUBLIC UTILITY COMPANY REBATE			
G. TOTAL INVESTMENT (1D-1E-1F)			$95

2. ENERGY SAVINGS (+)/COST(-):

DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS- Oct 1992

ENERGY SOURCE	COST $/MBTU(1)	SAVING(S) MBTU/YR(2)	ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELEC	$20.67	0.2	$ 3	14.65	$ 45
B. DIST	$5.69		$	17.70	$
C. RESID			$		$
D. NG			$		$
E. LPG	$7.76		$	20.60	$
F. COAL			$		$
G. SOLAR			$		$
H. GEOTH			$		$
I. BIOMA			$		$
J. REFUS			$		$
K. WIND			$		$
L. OTHER			$		$
M. DEMAND SAVINGS			$		$
N. TOTAL		0	$ 3		$ 45

3. NON ENERGY SAVINGS (+) OR COST (-):

A. ANNUAL RECURRING (+/-)
(1) DISCOUNT FACTOR (TABLE A)
(2) DISCOUNTED SAVINGS/COST (3A X 3A1)

B. NON RECURRING SAVINGS (+) OR COST (-)

ITEM	SAVINGS(+) COST(-)(1)	YEAR OF OCCUR. (2)	DISCOUNT FACTOR(3)	DISCOUNTED SAVINGS(+)COST(-)(4)
a.	$			$
b.	$			$
c.	$			$
d. TOTAL				$

C. TOTAL NON ENERGY DISCOUNTED SAVINGS (3A2+3Bd4)

4. SIMPLE PAYBACK 1G/(2N3+3A+(3Bd1/ECONOMIC LIFE)):	30.57 YEARS
5. TOTAL NET DISCOUNTED SAVINGS (2N5+3C):	$45
6. SAVINGS TO INVESTMENT RATION (SIR) 5/1G:	0.48
7. ADJUSTED INTERNAL RATE OF RETURN (AIRR):	-3.76%

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CONSTRUCTION COST ESTIMATE

PREPARED: March 1994 | SHEET 1 OF 2

PROJECT: Energy Savings Oppurtunity Survey

CONTRACT NO.: DACA 31-89-C-0198

LOCATION: Fort A.P. Hill, Virginia
AE PROJECT NO.: 92008
AE: Engineering Applications Consultants, P.C.

ESTIMATOR: JS | PRELIM:
CHECKED BY: VP | FINAL: X

SUMMARY: Shut Down Energy to Hotwater Heaters or Modify Controls

ITEM	QUANTITY		MATERIAL		LABOR		TOTAL COST
	NO.	MEAS	UNIT	COST	UNIT	COST	
Building 1253							
Water Heater Timer	1	EA	40.00	40	18.25	18	58
SUB-TOTAL				40		18	58

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CONSTRUCTION COST ESTIMATE	PREPARED: March 1994	SHEET 2 OF 2
PROJECT: Energy Savings Oppurtunity Survey LOCATION: Fort A.P. Hill, Virginia AE PROJECT NO.: AE: Engineering Applications Consultants, P.C.	CONTRACT NO.: DACA 31-89-C-0198 ESTIMATOR: JS CHECKED BY: VP	PRELIM: FINAL: X

SUMMARY: Shut Down Energy to Hotwater Heaters or Modify Controls

ITEM	QUANTITY		MATERIAL		LABOR		TOTAL COST
	NO.	MEAS	UNIT	COST	UNIT	COST	
SUBTOTAL PREVIOUS PAGE				40		18	58
MARK-UP ON LABOR SUB-TOTAL	21.0%			—		4	4 62
TAXES ON MATERIAL SUB-TOTAL	5.0%			2		—	2 64
OVERHEAD SUB-TOTAL	15.0%						10 73
PROFIT SUB-TOTAL	12.0%						9 82
PRIME MARK-UP ON SUB SUB-TOTAL							82
GRAND TOTAL							100

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Water Heater Controls- Install Timer to turn heater off during unoccupied periods

Heater Eff.=	100%	
Tank Capacity	40	Gallons
Utank=	0.22	Btu/F*Ft**2*Hr
Atank=	27	Ft**2
Ttank=	120	F
Tsurroundings=	65	F

Hour	Tank Temp F	Heat Lost per Hour (Btu's/Hr)	Total Heat Lost (Btu's)
0	120.0	326.7	
			324.5
1	119.2	322.2	
			320.0
2	118.5	317.8	
			315.6
3	117.8	313.5	
			311.3
4	117.0	309.2	
			307.0
5	116.3	304.9	
			302.8
6	115.6	300.8	
			298.7
7	114.9	296.6	
			294.6
8	114.3	292.6	
			290.6
9	113.6	288.6	
			286.6
10	112.9	284.6	
			282.7
11	112.3	280.7	
			278.8
12	111.6	276.9	
Total Heat Lost (Btu's Required to Return Water to 120F) =			(3,613.2)

Total Energy Required to Maintain 120F throughout 12 hour period=	3,920.4	Btu's
Total Energy Required to Return Water to 120F=	(3,613.2)	Btu's
Total Energy Saved per Day (Btu's)=	307.2	Btu's/Day
Total Energy Saved per Year=	0.112	MBtu's/Yr

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Field Latrine Energy Conservation Opportunities

LIFE CYCLE COST ANALYSIS SUMMARY
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)

LOCATION: Fort A.P. Hill, Virginia REGION: 3 PROJECT NO.: DACA 31-89-C-0198
PROJECT TITLE: Fort A.P. Hill- Energy Engineering Analysis Program FISCAL YEAR: 1994
DISCRETE PORTION NAME: Replace Incandescent Lighting w/Compact Fluorescent Lighting in Field Latrines
ANALYSIS DATE: January 1994 ECONOMIC LIFE (YR 15 PREPARER: JJS

1. INVESTMENT COSTS:

A. CONSTRUCTION COST	$	100	
B. SIOH	$	6	
C. DESIGN COST	$	6	
D. TOTAL COST (1A+1B+1C)	$	112	
E. SALVAGE VALUE OF EXISTING EQUIPMENT			
F. PUBLIC UTILITY COMPANY REBATE			
G. TOTAL INVESTMENT (1D-1E-1F)			$112

2. ENERGY SAVINGS (+)/COST(-):

DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS- Oct 1992

ENERGY SOURCE	COST $/MBTU(1)	SAVING(S) MBTU/YR(2)	ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELEC	$20.67	6.4	$ 132	11.77	$ 1,552
B. DIST	$5.69		$		$
C. RESID			$		$
D. NG			$		$
E. LPG	$7.76		$		$
F. COAL			$		$
G. SOLAR			$		$
H. GEOTH			$		$
I. BIOMA			$		$
J. REFUS			$		$
K. WIND			$		$
L. OTHER			$		$
M. DEMAND SAVINGS			$		$
N. TOTAL		6	$ 132		$ 1,552

3. NON ENERGY SAVINGS (+) OR COST (-):

A. ANNUAL RECURRING (+/-)	$45		
(1) DISCOUNT FACTOR (TABLE A)		11.12	
(2) DISCOUNTED SAVINGS/COST (3A X 3A1)			$500

B. NON RECURRING SAVINGS (+) OR COST (-)

ITEM	SAVINGS(+) COST(-)(1)	YEAR OF OCCUR. (2)	DISCOUNT FACTOR(3)	DISCOUNTED SAVINGS(+)COST(-)(4)
a.Comp.Fluor	$ -100	3	0.890	$ -89
b.Comp.Fluor	$ -100	6	0.790	$ -79
c.Comp.Fluor	$ -100	9	0.700	$ -70
d.Comp.Fluor	$ -100	12	0.620	$ -62
d. TOTAL	-400			$ -300

C. TOTAL NON ENERGY DISCOUNTED SAVINGS (3A2+3Bd4) $200

4. SIMPLE PAYBACK 1G/(2N3+3A+(3Bd1/ECONOMIC LIFE)):	0.74 YEARS
5. TOTAL NET DISCOUNTED SAVINGS (2N5+3C):	$1,753
6. SAVINGS TO INVESTMENT RATION (SIR) 5/1G:	15.72
7. ADJUSTED INTERNAL RATE OF RETURN (AIRR):	20.97%

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CONSTRUCTION COST ESTIMATE

PREPARED: March 1994 SHEET 1 OF 2

PROJECT: Energy Savings Oppurtunity Survey

CONTRACT NO.: DACA 31-89-C-0198

LOCATION: Fort A.P. Hill, Virginia
AE PROJECT NO.: 92008
AE: Engineering Applications Consultants, P.C.

ESTIMATOR: JS PRELIM:
CHECKED BY: VP FINAL: X

SUMMARY: Install Compact Fl. Lights in Field Latrines

ITEM	QUANTITY		MATERIAL		LABOR		TOTAL COST
	NO.	MEAS	UNIT	COST	UNIT	COST	
Field Latrine							
Replace Incandescent Lighting W/Compact Fl							
18 Watt Quad Fl. (LCFP18)	4	EA	23.00	92	0.50	2	94
SUB-TOTAL				92		2	94

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CONSTRUCTION COST ESTIMATE

CONSTRUCTION COST ESTIMATE	PREPARED: March 1994	SHEET 2 OF 2
PROJECT: Energy Savings Oppurtunity Survey	CONTRACT NO.: DACA 31-89-C-0198	
LOCATION: Fort A.P. Hill, Virginia		
AE PROJECT NO.:	ESTIMATOR: JS	PRELIM:
AE: Engineering Applications Consultants, P.C.	CHECKED BY: VP	FINAL: X

SUMMARY: Install Compact Fl. Lights in Field Latrines

ITEM	QUANTITY		MATERIAL		LABOR		TOTAL COST
	NO.	MEAS	UNIT	COST	UNIT	COST	
SUBTOTAL PREVIOUS PAG				92		2	94
MARK-UP ON LABOR	21.0%			----		0	0
SUB-TOTAL							94
TAXES ON MATERIAL	5.0%			5		----	5
SUB-TOTAL							99
OVERHEAD	15.0%						15
SUB-TOTAL							114
PROFIT	12.0%						14
SUB-TOTAL							128
PRIME MARK-UP ON SUB							
SUB-TOTAL							128
GRAND TOTAL							100

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ENGINEERING ANALYSIS

Sheet 1 of 1

By: JS

COMPACT FLUORESCENTS IN FIELD LATRINES

Project: Fort A. P. Hill ESOS

Date: 2-28-94

Contract No.: DACA 31-89-C-0198

EAC Project No.: 92008

CONSTRUCTION COST = $100

ENERGY SAVINGS - 6.38

$ SAVINGS (ANNUAL) = 132

Simple payback = 0.74

SIR = 15.72

HTING CALCULATION WORKSHEET CLIENT: FORT A.P. HILL BUILDING: Field LATRINES

pe of Lamp	# of Lamps	x	Watts/ Lamp	x	Ballast Usage	/ 1000 =	KW	x	Hours/ Week	x	Weeks/ Month	x	Months/ Year	=	KWH/Year	x	$/KWH	=	$/Year	
nc	4	x	75	x	1	/ 1000 =	.3	x	168	x	4.345	x	12	=	2857	x	①	=	$ ①	Standard
OMP FL PL-13	4	x	18	x	1.2	/ 1000 =	.0864	x	168	x	4.345	x	12	=	757	x	①	=	$ ①	Replacement

NSTALL COMPACT FLOURESCENT LAMPS n place of INCANDESCENT.

Energy Savings = 1871 KWH = $ ①SEE ECIP ANALYSIS SUMMARY SHEET

Demand Savings = ____ KW x ____ mo/yr = ____ KW x $____ /KW = $____

Cost = $____ x ____ = $____ Payback = ____ years

		x		x		/ 1000 =		x		x	4.345	x		=		x		=	$	Standard
		x		x		/ 1000 =		x		x	4.345	x		=		x		=	$	Replacement

Energy Savings = ____ KWH = $____

Demand Savings = ____ KW x ____ mo/yr = ____ KW x $____ /KW = $____

Cost = $____ x ____ = $____ Payback = ____ years

		x		x		/ 1000 =		x		x	4.345	x		=		x		=	$	Standard
		x		x		/ 1000 =		x		x	4.345	x		=		x		=	$	Replacement

Energy Savings = ____ KWH = $____

Demand Savings = ____ KW x ____ mo/yr = ____ KW x $____ /KW = $____

Cost = $____ x ____ = $____ Payback = ____ years

		x		x		/ 1000 =		x		x	4.345	x		=		x		=	$	Standard
		x		x		/ 1000 =		x		x	4.345	x		=		x		=	$	Replacement

Energy Savings = ____ KWH = $____

Demand Savings = ____ KW x ____ mo/yr = ____ KW x $____ /KW = $____

Cost = $____ x ____ = $____ Payback = ____ years

LIFE CYCLE COST ANALYSIS SUMMARY
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)

LOCATION: Fort A.P. Hill, Virginia REGION: 3 PROJECT NO.: DACA 31-89-C-0198
PROJECT TITLE: Fort A.P. Hill- Energy Engineering Analysis Program FISCAL YEAR: 1994
DISCRETE PORTION NAME: Occupancy Sensors- Field Latrine
ANALYSIS DATE: January 1994 ECONOMIC LIFE (YR 15 PREPARER: JJS

1. INVESTMENT COSTS:

A. CONSTRUCTION COST	$	200	
B. SIOH	$	11	
C. DESIGN COST	$	12	
D. TOTAL COST (1A+1B+1C)	$	223	
E. SALVAGE VALUE OF EXISTING EQUIPMENT			
F. PUBLIC UTILITY COMPANY REBATE			
G. TOTAL INVESTMENT (1D-1E-1F)			$223

2. ENERGY SAVINGS (+)/COST(-):

DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS- Oct 1992

ENERGY SOURCE	COST $/MBTU(1)	SAVING(S) MBTU/YR(2)	ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELEC	$20.67	2.1	$ 44	11.77	$ 516
B. DIST	$5.69		$		$
C. RESID			$		$
D. NG			$		$
E. LPG	$7.76		$		$
F. COAL			$		$
G. SOLAR			$		$
H. GEOTH			$		$
I. BIOMA			$		$
J. REFUS			$		$
K. WIND			$		$
L. OTHER			$		$
M. DEMAND SAVINGS			$		$
N. TOTAL		2	$ 44		$ 516

3. NON ENERGY SAVINGS (+) OR COST (-):

A. ANNUAL RECURRING (+/-)
(1) DISCOUNT FACTOR (TABLE A)
(2) DISCOUNTED SAVINGS/COST (3A X 3A1)

B. NON RECURRING SAVINGS (+) OR COST (-)

ITEM	SAVINGS(+) COST(-)(1)	YEAR OF OCCUR. (2)	DISCOUNT FACTOR(3)	DISCOUNTED SAVINGS(+)COST(-)(4)
a.	$			$
b.	$			$
c.	$			$
d.	$			$
e. TOTAL				$

C. TOTAL NON ENERGY DISCOUNTED SAVINGS (3A2+3Bd4)

4. SIMPLE PAYBACK 1G/(2N3+3A+(3Bd1/ECONOMIC LIFE)): 5.09 YEARS
5. TOTAL NET DISCOUNTED SAVINGS (2N5+3C): $516
6. SAVINGS TO INVESTMENT RATION (SIR) 5/1G: 2.31
7. ADJUSTED INTERNAL RATE OF RETURN (AIRR): 5.98%

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CONSTRUCTION COST ESTIMATE

PREPARED: March 1994

PROJECT: Energy Savings Oppurtunity Survey

CONTRACT NO.: DACA 31-89-C-0198

LOCATION: Fort A.P. Hill, Virginia
AE PROJECT NO.: 92008
AE: Engineering Applications Consultants, P.C.

ESTIMATOR: JS
CHECKED BY: VP

PRELIM:
FINAL: X

SUMMARY: Occupancy Sensors Field Latrine

ITEM	QUANTITY NO.	QUANTITY MEAS	MATERIAL UNIT	MATERIAL COST	LABOR UNIT	LABOR COST	TOTAL COST
Field Latrine							
Occupancy Sensors-Infrared Wall Switch	2	EA	77.00	154	7.00	14	168
SUB-TOTAL				154		14	168

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CONSTRUCTION COST ESTIMATE	PREPARED: March 1994	SHEET OF
PROJECT: Energy Savings Oppurtunity Survey	CONTRACT NO.: DACA 31-89-C-0198	SHEET 2 OF 2
LOCATION: Fort A.P. Hill, Virginia		
AE PROJECT NO.:	ESTIMATOR: JS	PRELIM:
AE: Engineering Applications Consultants, P.C.	CHECKED BY: VP	FINAL: X

SUMMARY: Occupancy Sensors Field Latrine

ITEM	QUANTITY		MATERIAL		LABOR		TOTAL COST
	NO.	MEAS	UNIT	COST	UNIT	COST	
SUBTOTAL PREVIOUS PAG				154		14	168
MARK-UP ON LABOR SUB-TOTAL	21.0%			----		3	3 171
TAXES ON MATERIAL SUB-TOTAL	5.0%			8		----	8 179
OVERHEAD SUB-TOTAL	15.0%						27 205
PROFIT SUB-TOTAL	12.0%						25 230
PRIME MARK-UP ON SUB SUB-TOTAL							230
GRAND TOTAL							200

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ENGINEERING ANALYSIS

Sheet 1 of 1

By: JS

Occupancy Sensors - Field Latrines

Project: Fort A. P. Hill ESOS

Date: 2-28-94

Contract No.: DACA 31-89-C-0198

EAC Project No.: 92008

		W/SYNERGISTICS (COMPACT FLUORESCENT LIGHTS INSTALLED)
Construction Cost =	200	
Energy Savings =	7.36	2.12
$ Savings =	135	44
Simple payback =	0.80	5.09 (SIR = 2.3)

GHTING CALCULATION WORKSHEET — CLIENT: FORT A.P HILL — BUILDING: FIELD LATRINES

pe of Lamp	# of Lamps	x	Watts/ Lamp	x	Ballast Usage	/ 1000 =	KW	x	Hours/ Week	x	Weeks/ Month	x	Months/ Year	=	KWH/Year	x	$/KWH	=	$/Year	
I	4	x	75	x	1.0	/ 1000 =	.3	x	30	x	4.345	x	12	=	470	x		=	$	Standard
I	4	x	75	x	1.0	/ 1000 =	.3	x	168	x	4.345	x	12	=	2857	x		=	$	Replacement

Occ. Sensors w/incandescent LIGHTS.

Energy Savings = 2387 KWH = $

Demand Savings = ____ KW x ____ mo/yr = ____ KW x $____ /KW = $____

Reduce Usage to 4hrs/day From 24hrs/day.

Cost = $____ x ____ = $____ Payback = ____ years

FL	4	x	18	x	1.2	/ 1000 =	.0864	x	30	x	4.345	x	12	=	135	x		=	$	Standard
FL	4	x	18	x	1.2	/ 1000 =	.0864	x	168	x	4.345	x	12	=	757	x		=	$	Replacement

Occ Sensors w/Compact Fluorescent Lights installed.

Energy Savings = 622 KWH = $

Demand Savings = ____ KW x ____ mo/yr = ____ KW x $____ /KW = $____

Cost = $____ x ____ = $____ Payback = ____ years

		x		x		/ 1000 =		x		x	4.345	x		=		x		=	$	Standard
		x		x		/ 1000 =		x		x	4.345	x		=		x		=	$	Replacement

Energy Savings = ____ KWH = $

Demand Savings = ____ KW x ____ mo/yr = ____ KW x $____ /KW = $____

Cost = $____ x ____ = $____ Payback = ____ years

		x		x		/ 1000 =		x		x	4.345	x		=		x		=	$	Standard
		x		x		/ 1000 =		x		x	4.345	x		=		x		=	$	Replacement

Energy Savings = ____ KWH = $

Demand Savings = ____ KW x ____ mo/yr = ____ KW x $____ /KW = $____

Cost = $____ x ____ = $____ Payback = ____ years

Study Building's Energy Conservation Opportunities with Synergistic Effects Applied to All New Buildings on Base

LIFE CYCLE COST ANALYSIS SUMMARY
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)

LOCATION: Fort A.P. Hill, Virginia REGION: 3 PROJECT NO.: DACA 31-89-C-0198
PROJECT TITLE: Fort A.P. Hill- Energy Engineering Analysis Program FISCAL YEAR: 1994
DISCRETE PORTION NAME: Low Flow Shower Heads
ANALYSIS DATE: January 1994 ECONOMIC LIFE (YR 20 PREPARER: JJS

1. INVESTMENT COSTS:

A. CONSTRUCTION COST	$	3,100	
B. SIOH	$	171	
C. DESIGN COST	$	186	
D. TOTAL COST (1A+1B+1C)	$	3,457	
E. SALVAGE VALUE OF EXISTING EQUIPMENT			
F. PUBLIC UTILITY COMPANY REBATE			
G. TOTAL INVESTMENT (1D-1E-1F)			$3,457

2. ENERGY SAVINGS (+)/COST(-):

DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS- Oct 1992

ENERGY SOURCE	COST $/MBTU(1)	SAVING(S) MBTU/YR(2)	ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELEC	$20.67	453.0	$ 9,364	14.65	$ 137,175
B. DIST	$5.69		$		$
C. RESID			$		$
D. NG			$		$
E. LPG	$7.76		$		$
F. COAL			$		$
G. SOLAR			$		$
H. GEOTH			$		$
I. BIOMA			$		$
J. REFUS			$		$
K. WIND			$		$
L. OTHER			$		$
M. DEMAND SAVINGS			$		$
N. TOTAL		453	$ 9,364		$ 137,175

3. NON ENERGY SAVINGS (+) OR COST (-):

A. ANNUAL RECURRING (+/-)
(1) DISCOUNT FACTOR (TABLE A)
(2) DISCOUNTED SAVINGS/COST (3A X 3A1)

B. NON RECURRING SAVINGS (+) OR COST (-)

ITEM	SAVINGS(+) COST(-)(1)	YEAR OF OCCUR. (2)	DISCOUNT FACTOR(3)	DISCOUNTED SAV-INGS(+)COST(-)(4)
a.	$			$
b.	$			$
c.	$			$
d. TOTAL				$

C. TOTAL NON ENERGY DISCOUNTED SAVINGS (3A2+3Bd4)

4. SIMPLE PAYBACK 1G/(2N3+3A+(3Bd1/ECONOMIC LIFE)):	0.37 YEARS
5. TOTAL NET DISCOUNTED SAVINGS (2N5+3C):	$137,175
6. SAVINGS TO INVESTMENT RATION (SIR) 5/1G:	39.69
7. ADJUSTED INTERNAL RATE OF RETURN (AIRR):	21.02%

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CONSTRUCTION COST ESTIMATE

PREPARED: March 1994 SHEET 1 OF 2

PROJECT: Energy Savings Oppurtunity Survey

CONTRACT NO.: DACA 31-89-C-0198

LOCATION: Fort A.P. Hill, Virginia
AE PROJECT NO.: 92008
AE: Engineering Applications Consultants, P.C.

ESTIMATOR: JS PRELIM:
CHECKED BY: VP FINAL: X

SUMMARY: Low Flow Shower Heads

ITEM	QUANTITY		MATERIAL		LABOR		TOTAL COST
	NO.	MEAS	UNIT	COST	UNIT	COST	
Low Flow Shower Heads							
SUBGROUP							
Administration Buildings	3	EA	25.00	75	7.00	21	96
Dinning Facilities		EA	25.00		7.00		
Housing Facilities	67	EA	25.00	1,675	7.00	469	2,144
SUB-TOTAL				1,750		490	2,240

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CONSTRUCTION COST ESTIMATE	PREPARED: March 1994	SHEET 2 OF 2
PROJECT: Energy Savings Oppurtunity Survey LOCATION: Fort A.P. Hill, Virginia AE PROJECT NO.: AE: Engineering Applications Consultants, P.C.	CONTRACT NO.: DACA 31-89-C-0198 ESTIMATOR: JS CHECKED BY: VP	PRELIM: FINAL: X

SUMMARY: Low Flow Shower Heads

ITEM	QUANTITY		MATERIAL		LABOR		TOTAL COST
	NO.	MEAS	UNIT	COST	UNIT	COST	
SUBTOTAL PREV. PAGE				1,750		490	2,240
MARK-UP ON LABOR SUB-TOTAL	21.0%			----		103	103 2,343
TAXES ON MATERIAL SUB-TOTAL	5.0%			88		----	88 2,430
OVERHEAD SUB-TOTAL	15.0%						365 2,795
PROFIT SUB-TOTAL	12.0%						335 3,130
PRIME MARK-UP ON SUB SUB-TOTAL							3,130
GRAND TOTAL							3,100

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ECO Summary: Low Flow Shower Heads

STUDY BUILDING	Floor Area (Ft**2)	Existing Energy Usage MBtu/Yr	$/Yr	Total Energy Savings MBtu/Yr	$/Yr
172	4,272	438	3,400	0	0
174	4,800	379	7,828	37	769
1253	5,000	281	5,802	11	232

Sub Group	Study Bldg.	Applied Subgroup (Ft**2)	Average Study Building Savings MBtu/Ft**2-Yr	$/Ft**2-Yr		Total Applied Group Savings MBtu/Yr	$/Yr
Admin	1253	11,800	0.0031	0.063		36	746
Housing	174	53,820	0.0078	0.160		417	8,622
Dining	172	4,272	0.0000	0.000		0	0
					TOTAL	453.21	9,367.94

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Building Number	Dinning 172	Housing 174	Admin 1,253	Field Latrines 412
Floor Area (Ft**2)	4,272	4,800	5,000	143
Group Floor Area (Ft**2)	4,272	53,820	11,800	3,931

Existing Energy Usage- Bldg 1253	
MBtu/Yr	280.7
$/Yr	5,802
Existing Energy Usage- Bldg 174	
MBtu/Yr	378.7
$/Yr	7,828
Existing Energy Usage- Bldg 172	
MBtu/Yr	438.1
$/Yr	3,400

Energy Costs	($/MMBTU)
Electricity	20.67
Fuel Oil	5.69
LP Gas	7.76

ECO	ECO Savings		Average Study Blg Savings		Average Study Blg Cost		Average Group Savings		Average Group Cost		No. of Units Per Study Bldg	Units per Study Blg Floor Area	Total Units Per Group
Subgroup A-1- Study Blg 1253	MBtu/Yr	$/Yr	MBtu/ft**2	$/Yr/ft**2	Materials $	Labor $	MBtu/Yr	$/Yr	Materials $	Labor $			
Low Flow Shower Heads	11.2	232	0.0031	0.0633	25	7	36.1	746	81	23	1	0.000273	3
Occupancy Sensors	31	641	0.0085	0.1751	616	56	99.9	2,066	1,986	181	8	0.002186	26
Compact Fluorescent Lights	6.93	143	0.0019	0.0391	192	4	22.3	462	619	13	8	0.002186	26
Energy Saving Fluorescent Lamps	22.8	471	0.0062	0.1288	497	216	73.5	1,519	1,602	696	144	0.039344	464
Exit Signs	5.38	111	0.0015	0.0304	500	100	17.3	359	1,612	322	4	0.001093	13
F32 T-8 Lighting System	39.7	821	0.0108	0.2242	2317	607	128.0	2,646	7,470	1,957	53	0.014481	171
Economizer Controls	24	496	0.0066	0.1355	2258	1280	77.4	1,599	7,280	4,127	1	0.000273	3
Daylight Dimming Controls	6.2	128	0.0017	0.0350	720	400	20.0	413	2,321	1,290	4	0.001093	13
Water Heater Timers	0.112	2	0.0000	0.0006	40	18	0.4	7	129	58	1	0.000273	3
Water Heater Insulation	1.17	24	0.0003	0.0066	25	18	3.8	78	81	58	1	0.000273	3

ECO Subgroup B-1- Study Blg 174	ECO Savings MBtu/Yr	ECO Savings $/Yr	Average Study Blg Savings MBtu/ft**2	Average Study Blg Savings $/Yr/ft**2	Average Study Blg Cost Materials $/ft**2	Average Study Blg Cost Labor $/ft**2	Average Group Savings MBtu/Yr	Average Group Savings $/Yr	Average Group Cost Materials $	Average Group Cost Labor $	No. of Units Per Study Bldg	Units per Study Blg Floor Area	Total Units Per Group
Low Flow Shower Heads	37.2	769	0.0078	0.1602	150	42	417.1	8,622	1,682	471	6	0.00125	67
Compact Fluorescent Lighting	41.9	866	0.0087	0.1804	322	7	469.8	9,711	3,610	78	14	0.002917	157
Occupancy Sensors	55.4	1,145	0.0115	0.2386	1078	98	621.2	12,840	12,087	1,099	14	0.002917	157
Water Heater Timer	1.13	23	0.0002	0.0049	40	18	12.7	262	449	202	1	0.000208	11
Energy Savings Fluorescent Lamps	19.6	405	0.0041	0.0844	490	213	219.8	4,543	5,494	2,388	142	0.029583	1,592
F32 T-8 Lighting System	12	248	0.0025	0.0517	2904	726	134.6	2,781	32,561	8,140	33	0.006875	370
Water Heater Insulation	1.17	24	0.0002	0.0050	25	18	13.1	271	280	202	1	0.000208	18

ECO Subgroup D-1- Study Blg 172	ECO Savings MBtu/Yr	ECO Savings $/Yr	Average Study Blg Savings MBtu/ft**2	Average Study Blg Savings $/Yr/ft**2	Average Study Blg Cost Materials $	Average Study Blg Cost Labor $	Average Group Savings MBtu/Yr	Average Group Savings $/Yr	Average Group Cost Materials $	Average Group Cost Labor $	No. of Units Per Study Bldg	Units per Study Blg Floor Area	Total Units Per Group
Compact Fluorescent Lights	4.12	85	0.0010	0.0199	142	3	4.1	85	142.00	3.00	6	0.001404	6
Energy Savings Fluorescent Lamps	3.68	76	0.0009	0.0178	131	57	3.7	76	131.00	57.00	38	0.008895	38
Occupancy Sensors	15.46	320	0.0036	0.0748	1213	284	15.5	320	1,213.00	284.00	15	0.003511	15
Exit Sign Retrofit	14.08	291	0.0033	0.0681	1375	275	14.1	291	1,375.00	275.00	11	0.002575	11
Water Heater Timers	0.5	10	0.0001	0.0024	40	18	0.5	10	40.00	18.00	1	0.000234	1
DayLight Dimming Controls	0.56	12	0.0001	0.0027	180	100	0.6	12	180.00	100.00	1	0.000234	1

ECO Subgroup E-2 Latrines	ECO Savings MBtu/Yr	ECO Savings $/Yr	Average Study Blg Savings MBtu/ft**2	Average Study Blg Savings $/Yr/ft**2	Average Study Blg Cost Materials $	Average Study Blg Cost Labor $	Average Group Savings MBtu/Yr	Average Group Savings $/Yr	Average Group Cost Materials $	Average Group Cost Labor $	No. of Units Per Study Bldg	Units per Study Blg Floor Area	Total Units Per Group
Compact Flourescent Lights	6.38	132	0.0446	0.9222	23	2	175.4	3,625	632.26	54.98	4	0.027972	119
Occupancy Sensors	2.12	44	0.0148	0.3064	154	14	58.3	1,205	4,233.38	384.85	2	0.013986	60

New Buildings List- Buildings built after 1985 Fort A.P. Hill

SUBGROUP A-1

Bldg. No	Description		Floor Area (Ft**2)
1247	Entomology Facility		1,800
1252	General Inst. Bldg		5,000
1253	Range Control Bldg		5,000
		TOTAL	11,800

SUBGROUP B-1

Bldg. No	Description		Floor Area (Ft**2)
174	Guest House		4,800
290	Log Cabin Bullocks Lake		1,056
1350	FH NCO & ENL, QTRS 8		7,256
1351	FH NCO & ENL, QTRS 6		7,256
1352	FH NCO & ENL, QTRS 4		7,256
1353	FH NCO & ENL, QTRS 2		3,804
1354	FH Colonel, QTRS 1		2,553
1355	CO Grade & WO, QTRS 3		4,846
1356	FH NCO & ENL, QTRS 5		7,737
1357	FH NCO & ENL, QTRS 7		7,256
		TOTAL	53,820

LIFE CYCLE COST ANALYSIS SUMMARY
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)

LOCATION: Fort A.P. Hill, Virginia REGION: 3 PROJECT NO.: DACA 31-89-C-0198
PROJECT TITLE: Fort A.P. Hill- Energy Engineering Analysis Program FISCAL YEAR: 1994
DISCRETE PORTION NAME: Replace Incandescent Lighting w/Compact Fluorescent Lighting
ANALYSIS DATE: January 1994 ECONOMIC LIFE (YR 15 PREPARER: JJS

1. INVESTMENT COSTS:

A. CONSTRUCTION COST	$	9,827	
B. SIOH	$	540	
C. DESIGN COST	$	590	
D. TOTAL COST (1A+1B+1C)	$	10,957	
E. SALVAGE VALUE OF EXISTING EQUIPMENT			
F. PUBLIC UTILITY COMPANY REBATE			
G. TOTAL INVESTMENT (1D-1E-1F)			$10,957

2. ENERGY SAVINGS (+)/COST(-):

DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS- Oct 1992

ENERGY SOURCE	COST $/MBTU(1)	SAVING(S) MBTU/YR(2)	ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELEC	$20.67	672.0	$ 13,890	11.77	$ 163,488
B. DIST	$5.69		$		$
C. RESID			$		$
D. NG			$		$
E. LPG	$7.76		$		$
F. COAL			$		$
G. SOLAR			$		$
H. GEOTH			$		$
I. BIOMA			$		$
J. REFUS			$		$
K. WIND			$		$
L. OTHER			$		$
M. DEMAND SAVINGS			$		$
N. TOTAL		672	$ 13,890		$ 163,488

3. NON ENERGY SAVINGS (+) OR COST (-):

A. ANNUAL RECURRING (+/-)	$2,910		
(1) DISCOUNT FACTOR (TABLE A)		11.12	
(2) DISCOUNTED SAVINGS/COST (3A X 3A1)			$32,359

B. NON RECURRING SAVINGS (+) OR COST (-)

ITEM	SAVINGS(+) COST(-)(1)	YEAR OF OCCUR. (2)	DISCOUNT FACTOR(3)	DISCOUNTED SAV-INGS(+)COST(-)(4)
a.Comp.Fluor	$ -7700	3	0.890	$ -6853
b.Comp.Fluor	$ -7700	6	0.790	$ -6083
c.Comp.Fluor	$ -7700	9	0.700	$ -5390
d.Comp.Fluor	$ -7700	12	0.620	$ -4774
d. TOTAL	-30800			$ -23100

C. TOTAL NON ENERGY DISCOUNTED SAVINGS (3A2+3Bd4) $9,259

4. SIMPLE PAYBACK 1G/(2N3+3A+(3Bd1/ECONOMIC LIFE)):	0.74 YEARS
5. TOTAL NET DISCOUNTED SAVINGS (2N5+3C):	$172,747
6. SAVINGS TO INVESTMENT RATION (SIR) 5/1G:	15.77
7. ADJUSTED INTERNAL RATE OF RETURN (AIRR):	20.99%

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Engineering
Applications
Consultants

A Professional
Corporation

9004-B Crownwood Ct.
Burke, Virginia 22015-1630
(703) 978-0923

ENGINEERING ANALYSIS

Sheet ____ of ____

By: JS

REPLACE INCANDESCENT W/ COMPACT FLUORESCENT

Project: Fort A. P. Hill ESOS   Date: 2-28-94

Contract No.: DACA 31-89-C-0198   EAC Project No.: 92008

LAMP ECONOMICAL LIFE OVER 15 YRS

OPERATING HOURS = $\frac{10 \text{ HRS}}{\text{day}} \times \frac{5 \text{ days}}{\text{WK}} \times \frac{52 \text{ WKS}}{\text{YR}} = 2600 \text{ HRS/YR}$

A-19 Incandescent LAMP LIFE = 750 hrs

Useful Life $= \frac{750 \text{ hrs}}{2600 \text{ HRS/YR}} = .3 \text{ YR}$

ANNUAL MAINTENANCE COSTS:

308 LAMPS $\times \frac{3 \text{ changes}}{\text{YR}} \times \frac{3.15}{\text{bulb \& FIXTURE CLEAN}} = \$2910/\text{YR}$

COMPACT FLUORESCENT (PL) LAMPS AVG LIFE = 10,000 HRS

USEFUL LIFE $= \frac{10{,}000 \text{ HRS}}{2600 \text{ HRS/YR}} = 3.85$ yrs (use 3 yrs)

ANNUAL MAINTENANCE: (OVER 15 yrs) - change lamps in yrs 3, 6, 9, 12

308 LAMPS $\times$ 1 change $\times \frac{\$25.00}{\text{LAMP \& FIXTURE CLEAN}} = 7{,}700$

CONSTRUCTION COST ESTIMATE	PREPARED: March 1994 SHEET 1 OF 2
PROJECT: Energy Savings Oppurtunity Survey LOCATION: Fort A.P. Hill, Virginia AE PROJECT NO.: 92008 AE: Engineering Applications Consultants, P.C.	CONTRACT NO.: DACA 31-89-C-0198 ESTIMATOR: JS PRELIM: CHECKED BY: VP FINAL: X

SUMMARY: Install Compact Fluorescent Lights

ITEM	QUANTITY		MATERIAL		LABOR		TOTAL COST
	NO.	MEAS	UNIT	COST	UNIT	COST	
Replace Incandescent Lighting W/Compact Fl							
SUBGROUP							
Administration Buildings							
18 Watt Quad Fl. (LCFP18)	26	EA	23.00	598	0.50	13	611
Dinning Facilities							
15 Watt Compact Fl (LEL15)	2	EA	25.00	50	0.50	1	51
18 Watt Quad Fl. (LCFP18)	4	EA	23.00	92	0.50	2	94
Housing Facilities							
18 Watt Quad Fl. (LCFP18)	157	EA	23.00	3,611	0.50	79	3,690
Field Latrines							
18 Watt Quad Fl. (LCFP18)	119	EA	23.00	2,737	0.50	60	2,797
SUB-TOTAL				7,088		155	7,243

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CONSTRUCTION COST ESTIMATE

PREPARED: March 1994 SHEET 2 OF 2

PROJECT: Energy Savings Oppurtunity Survey

CONTRACT NO.: DACA 31-89-C-0198

LOCATION: Fort A.P. Hill, Virginia
AE PROJECT NO.:
AE: Engineering Applications Consultants, P.C.

ESTIMATOR: JS PRELIM:
CHECKED BY: VP FINAL: X

SUMMARY: Install Compact Fluorescent Lights

ITEM	QUANTITY NO.	QUANTITY MEAS	MATERIAL UNIT	MATERIAL COST	LABOR UNIT	LABOR COST	TOTAL COST
SUBTOTAL PREV. PAGE				7,088		155	7,243
MARK-UP ON LABOR SUB-TOTAL	21.0%			---		33	33 7,276
TAXES ON MATERIAL SUB-TOTAL	5.0%			354		---	354 7,630
OVERHEAD SUB-TOTAL	15.0%						1,144 8,774
PROFIT SUB-TOTAL	12.0%						1,053 9,827
PRIME MARK-UP ON SUB SUB-TOTAL							9,827
GRAND TOTAL							9,800

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ECO Summary: Replace Incandescent Lighting With Compact Fluorescents

STUDY BUILDING	Floor Area (Ft**2)	Existing Energy Usage MBtu/Yr	$/Yr	Total Energy Savings MBtu/Yr	$/Yr
172	4,272	438	3,400	4	85
174	4,800	379	7,828	42	866
1253	5,000	281	5,802	7	143
412	143	9.7	200	6	132

Sub Group	Study Bldg.	Applied Subgroup (Ft**2)	Average Study Building Savings MBtu/Ft**2-Yr	$/Ft**2-Yr		Total Applied Group Savings MBtu/Yr	$/Yr
Admin	1253	11,800	0.0019	0.0391		22	462
Housing	174	53,820	0.0087	0.1804		470	9,711
Dining	172	4,272	0.0010	0.0199		4	85
Field Latrine	412	3,931	0.0446	0.9222		175	3,625
					TOTAL	671.65	13,882.99

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	Dinning	Housing	Admin	Field Latrines
Building Number	172	174	1,253	412
Floor Area (Ft**2)	4,272	4,800	5,000	143
Group Floor Area (Ft**2)	4,272	53,820	11,800	3,931

Existing Energy Usage- Bldg 1253	
MBtu/Yr	280.7
$/Yr	5,802
Existing Energy Usage- Bldg 174	
MBtu/Yr	378.7
$/Yr	7,828
Existing Energy Usage- Bldg 172	
MBtu/Yr	438.1
$/Yr	3,400

Energy Costs	($/MMBTU)
Electricity	20.67
Fuel Oil	5.69
LP Gas	7.76

ECO	ECO Savings		Average Study Blg Savings		Average Study Blg Cost		Average Group Savings		Average Group Cost		No. of Units Per Study Bldg	Units per Study Blg Floor Area	Total Units Per Group
Subgroup A-1- Study Blg 1253	MBtu/Yr	$/Yr	MBtu/ft**2	$/Yr/ft**2	Materials $	Labor $	MBtu/Yr	$/Yr	Materials $	Labor $			
Low Flow Shower Heads	11.2	232	0.0031	0.0633	25	7	36.1	746	81	23	1	0.000273	3
Occupancy Sensors	31	641	0.0085	0.1751	616	56	99.9	2,066	1,986	181	8	0.002186	26
Compact Fluorescent Lights	6.93	143	0.0019	0.0391	192	4	22.3	462	619	13	8	0.002186	26
Energy Saving Fluorescent Lamps	22.8	471	0.0062	0.1288	497	216	73.5	1,519	1,602	696	144	0.039344	464
Exit Signs	5.38	111	0.0015	0.0304	500	100	17.3	359	1,612	322	4	0.001093	13
F32 T-8 Lighting System	39.7	821	0.0108	0.2242	2317	607	128.0	2,646	7,470	1,957	53	0.014481	171
Economizer Controls	24	496	0.0066	0.1355	2258	1260	77.4	1,599	7,280	4,127	1	0.000273	3
Daylight Dimming Controls	6.2	128	0.0017	0.0350	720	400	20.0	413	2,321	1,290	4	0.001093	13
Water Heater Timers	0.112	2	0.0000	0.0006	40	18	0.4	7	129	58	1	0.000273	3
Water Heater Insulation	1.17	24	0.0003	0.0066	25	18	3.8	78	81	58	1	0.000273	3

ECO Subgroup B-1- Study Blg 174	ECO Savings MBtu/Yr	 $/Yr	Average Study Blg Savings MBtu/ft**2	 $/Yr/ft**2	Average Study Blg Cost Materials $/ft**2	 Labor $/ft**2	Average Group Savings MBtu/Yr	 $/Yr	Average Group Cost Materials $	 Labor $	No. of Units Per Study Bldg	Units per Study Blg Floor Area	Total Units Per Group
Low Flow Shower Heads	37.2	769	0.0078	0.1602	150	42	417.1	8,622	1,682	471	6	0.00125	67
Compact Fluorescent Lighting	41.9	868	0.0087	0.1804	322	7	469.8	9,711	3,610	78	14	0.002917	157
Occupancy Sensors	55.4	1,145	0.0115	0.2386	1078	98	621.2	12,840	12,087	1,099	14	0.002917	157
Water Heater Timer	1.13	23	0.0002	0.0049	40	18	12.7	262	449	202	1	0.000208	11
Energy Savings Fluorescent Lamps	19.6	405	0.0041	0.0844	490	213	219.8	4,543	5,494	2,388	142	0.029583	1,592
F32 T-8 Lighting System	12	248	0.0025	0.0517	2904	728	134.6	2,781	32,561	8,140	33	0.006875	370
Water Heater Insulation	1.17	24	0.0002	0.0050	25	18	13.1	271	280	202	1	0.000208	18

ECO Subgroup D-1- Study Blg 172	ECO Savings MBtu/Yr	 $/Yr	Average Study Blg Savings MBtu/ft**2	 $/Yr/ft**2	Average Study Blg Cost Materials $	 Labor $	Average Group Savings MBtu/Yr	 $/Yr	Average Group Cost Materials $	 Labor $	No. of Units Per Study Bldg	Units per Study Blg Floor Area	Total Units Per Group
Compact Fluorescent Lights	4.12	85	0.0010	0.0199	142	3	4.1	85	142.00	3.00	6	0.001404	6
Energy Savings Fluorescent Lamps	3.68	76	0.0009	0.0178	131	57	3.7	76	131.00	57.00	38	0.008895	38
Occupancy Sensors	15.46	320	0.0036	0.0748	1213	284	15.5	320	1,213.00	284.00	15	0.003511	15
Exit Sign Retrofit	14.08	291	0.0033	0.0681	1375	275	14.1	291	1,375.00	275.00	11	0.002575	11
Water Heater Timers	0.5	10	0.0001	0.0024	40	18	0.5	10	40.00	18.00	1	0.000234	1
DayLight Dimming Controls	0.58	12	0.0001	0.0027	180	100	0.6	12	180.00	100.00	1	0.000234	1

ECO Subgroup E-2 Latrines	ECO Savings MBtu/Yr	 $/Yr	Average Study Blg Savings MBtu/ft**2	 $/Yr/ft**2	Average Study Blg Cost Materials $	 Labor $	Average Group Savings MBtu/Yr	 $/Yr	Average Group Cost Materials $	 Labor $	No. of Units Per Study Bldg	Units per Study Blg Floor Area	Total Units Per Group
Compact Flourescent Lights	6.38	132	0.0446	0.9222	23	2	175.4	3,625	632.26	54.98	4	0.027972	119
Occupancy Sensors	2.12	44	0.0148	0.3064	154	14	58.3	1,205	4,233.38	384.85	2	0.013986	60

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New Buildings List- Buildings built after 1985 Fort A.P. Hill

SUBGROUP A-1

Bldg. No	Description		Floor Area (Ft**2)
1247	Entomology Facility		1,800
1252	General Inst. Bldg		5,000
1253	Range Control Bldg		5,000
		TOTAL	11,800

SUBGROUP B-1

Bldg. No	Description		Floor Area (Ft**2)
174	Guest House		4,800
290	Log Cabin Bullocks Lake		1,056
1350	FH NCO & ENL, QTRS 8		7,256
1351	FH NCO & ENL, QTRS 6		7,256
1352	FH NCO & ENL, QTRS 4		7,256
1353	FH NCO & ENL, QTRS 2		3,804
1354	FH Colonel, QTRS 1		2,553
1355	CO Grade & WO, QTRS 3		4,846
1356	FH NCO & ENL, QTRS 5		7,737
1357	FH NCO & ENL, QTRS 7		7,256
		TOTAL	53,820

SUBGROUP D-1

Bldg. No	Description		Floor Area (Ft**2)
172	Open Dinning NCO		4,272
		TOTAL	4,272

SUBGROUP E-1

Bldg. No	Description		Floor Area (Ft**2)
1241	Detached Latrine/Shwr		533

SUBGROUP E-2

Bldg. No	Description		Floor Area (Ft**2)
412	Detached Latrine TA12		143
413	Detached Latrine TA12		143
529	Detached Latrine Area 15		90
531	Detached Latrine TA15		143
733	Detached Latrine TNG 18		90
745	Detached Latrine TNG 14		144
746	Detached Latrine Rapp. Compound		144
748	Detached Latrine TA 18		143
826	Detached Latrine Range 42		143
828	Detached Latrine TNG 28		144
839	Detached Latrine at Repell. Twr		143
924	Detached Latrine		108
928	Detached Latrine		144
1008	Detached Latrine- Range 25		143
1024	Detached Latrine-Range 24		144
1108	Detached Latrine-Range 28P		144
1109	Detached Latrine-Range 28P		144
1110	Detached Latrine-Range 28P		144
1114	Detached Latrine		144
1116	Detached Latrine-Range 33		143
1202	Detached Latrine- Range 7		143
1254	Detached Latrine-Range 37		143
1256	Detached Latrine		108
1263	Detached Latrine-Range 6		143
1403	Detached Latrine-Tr Area 5		90
1405	Detached Latrine-Tr Area 3		90
1428	Detached Latrine-Tr Area 3		144
1619	Detached Latrine-Tr Area 21		90
1670	Detached Latrine-Tr Area 21		144
S 1272	Detached Latrine- Range 33		108
		TOTAL	3,931

5011

LIFE CYCLE COST ANALYSIS SUMMARY
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)

LOCATION: Fort A.P. Hill, Virginia REGION: 3 PROJECT NO.: DACA 31-89-C-0198
PROJECT TITLE: Fort A.P. Hill- Energy Engineering Analysis Program FISCAL YEAR: 1994
DISCRETE PORTION NAME: Occupancy Sensors
ANALYSIS DATE: January 1994 ECONOMIC LIFE (YRS 15 PREPARER: JJS

1. INVESTMENT COSTS:

A. CONSTRUCTION COST	$	29,681	
B. SIOH	$	1,632	
C. DESIGN COST	$	1,781	
D. TOTAL COST (1A+1B+1C)	$	33,094	
E. SALVAGE VALUE OF EXISTING EQUIPMENT			
F. PUBLIC UTILITY COMPANY REBATE			
G. TOTAL INVESTMENT (1D-1E-1F)			$33,094

2. ENERGY SAVINGS (+)/COST(-):

DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS- Oct 1992

ENERGY SOURCE	COST $/MBTU(1)	SAVING(S) MBTU/YR(2)	ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELEC	$20.67	795.0	$ 16,433	11.77	$ 193,412
B. DIST	$5.69		$		$
C. RESID			$		$
D. NG			$		$
E. LPG	$7.76		$		$
F. COAL			$		$
G. SOLAR			$		$
H. GEOTH			$		$
I. BIOMA			$		$
J. REFUS			$		$
K. WIND			$		$
L. OTHER			$		$
M. DEMAND SAVINGS			$		$
N. TOTAL		795	$ 16,433		$ 193,412

3. NON ENERGY SAVINGS (+) OR COST (-):

A. ANNUAL RECURRING (+/-)
(1) DISCOUNT FACTOR (TABLE A)
(2) DISCOUNTED SAVINGS/COST (3A X 3A1)

B. NON RECURRING SAVINGS (+) OR COST (-)

ITEM	SAVINGS(+) COST(-)(1)	YEAR OF OCCUR. (2)	DISCOUNT FACTOR(3)	DISCOUNTED SAVINGS(+)COST(-)(4)
a.	$			$
b.	$			$
c.	$			$
d. TOTAL				$

C. TOTAL NON ENERGY DISCOUNTED SAVINGS (3A2+3Bd4)

4. SIMPLE PAYBACK 1G/(2N3+3A+(3Bd1/ECONOMIC LIFE)): 2.01 YEARS
5. TOTAL NET DISCOUNTED SAVINGS (2N5+3C): $193,412
6. SAVINGS TO INVESTMENT RATION (SIR) 5/1G: 5.84
7. ADJUSTED INTERNAL RATE OF RETURN (AIRR): 12.99%

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CONSTRUCTION COST ESTIMATE

PREPARED: March 1994 SHEET 1 OF 2

PROJECT: Energy Savings Oppurtunity Survey

CONTRACT NO.: DACA 31-89-C-0198

LOCATION: Fort A.P. Hill, Virginia
AE PROJECT NO.: 92008
AE: Engineering Applications Consultants, P.C.

ESTIMATOR: JS
CHECKED BY: VP

PRELIM:
FINAL: X

SUMMARY: Occupancy Sensors

ITEM	QUANTITY		MATERIAL		LABOR		TOTAL COST
	NO.	MEAS	UNIT	COST	UNIT	COST	
Occupancy Sensors- Infrared Wall Switch							
SUBGROUP							
Administration Buildings	26	EA	77.00	2,002	7.00	182	2,184
Dinning Facilities	15	EA	77.00	1,155	7.00	105	1,260
Housing Facilities	157	EA	77.00	12,089	7.00	1,099	13,188
Field Latrines	60	EA	77.00	4,620	7.00	420	5,040
SUB-TOTAL				19,866		1,806	21,672

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CONSTRUCTION COST ESTIMATE	PREPARED: March 1994 SHEET OF
PROJECT: Energy Savings Oppurtunity Survey	SHEET 2 OF 2
	CONTRACT NO.: DACA 31-89-C-0198
LOCATION: Fort A.P. Hill, Virginia	
AE PROJECT NO.:	ESTIMATOR: JS PRELIM:
AE: Engineering Applications Consultants, P.C.	CHECKED BY: VP FINAL: X

SUMMARY: Occupancy Sensors

ITEM	QUANTITY		MATERIAL		LABOR		TOTAL COST
	NO.	MEAS	UNIT	COST	UNIT	COST	
SUBTOTAL PREV. PAGE				19,866		1,806	21,672
MARK-UP ON LABOR SUB-TOTAL	21.0%			----		379	379 22,051
TAXES ON MATERIAL SUB-TOTAL	5.0%			993		----	993 23,045
OVERHEAD SUB-TOTAL	15.0%						3,457 26,501
PROFIT SUB-TOTAL	12.0%						3,180 29,681
PRIME MARK-UP ON SUB SUB-TOTAL							29,681
GRAND TOTAL							29,700

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ECO Summary: Occupancy Sensors

STUDY BUILDING	Floor Area (Ft**2)	Existing Energy Usage MBtu/Yr	Existing Energy Usage $/Yr	Total Energy Savings MBtu/Yr	Total Energy Savings $/Yr
172	4,272	438	3,400	15	320
174	4,800	379	7,828	55	1,145
1253	5,000	281	5,802	31	641
412	143	2.5	52	2.1	44

Sub Group	Study Bldg.	Applied Subgroup (Ft**2)	Average Study Building Savings MBtu/Ft**2-Yr	Average Study Building Savings $/Ft**2-Yr		Total Applied Group Savings MBtu/Yr	Total Applied Group Savings $/Yr
Admin	1253	11,800	0.0085	0.1751		100	2,066
Housing	174	53,820	0.0115	0.2386		621	12,840
Dining	172	4,272	0.0036	0.0748		15	320
Field Latrine	412	3,931	0.0148	0.3064		58	1,205
					TOTAL	794.86	16,429.67

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Building Number	Dinning 172	Housing 174	Admin 1,253	Field Latrines 412
Floor Area (Ft**2)	4,272	4,800	5,000	143
Group Floor Area (Ft**2)	4,272	53,820	11,800	3,931

Existing Energy Usage- Bldg 1253	
MBtu/Yr	280.7
$/Yr	5,802
Existing Energy Usage- Bldg 174	
MBtu/Yr	378.7
$/Yr	7,828
Existing Energy Usage- Bldg 172	
MBtu/Yr	438.1
$/Yr	3,400

Energy Costs	($/MMBTU)
Electricity	20.67
Fuel Oil	5.69
LP Gas	7.76

ECO	ECO Savings		Average Study Blg Savings		Average Study Blg Cost		Average Group Savings		Average Group Cost		No. of Units Per Study Bldg	Units per Study Blg Floor Area	Total Units Per Group
Subgroup A-1- Study Blg 1253	MBtu/Yr	$/Yr	MBtu/ft**2	$/Yr/ft**2	Materials $	Labor $	MBtu/Yr	$/Yr	Materials $	Labor $			
Low Flow Shower Heads	11.2	232	0.0031	0.0633	25	7	36.1	746	81	23	1	0.000273	3
Occupancy Sensors	31	641	0.0085	0.1751	616	56	99.9	2,066	1,986	181	8	0.002186	26
Compact Fluorescent Lights	6.93	143	0.0019	0.0391	192	4	22.3	462	619	13	8	0.002186	26
Energy Saving Fluorescent Lamps	22.8	471	0.0062	0.1288	497	216	73.5	1,519	1,602	696	144	0.039344	464
Exit Signs	5.38	111	0.0015	0.0304	500	100	17.3	359	1,612	322	4	0.001093	13
F32 T-8 Lighting System	39.7	821	0.0108	0.2242	2317	607	128.0	2,646	7,470	1,957	53	0.014481	171
Economizer Controls	24	496	0.0066	0.1355	2258	1280	77.4	1,599	7,280	4,127	1	0.000273	3
Daylight Dimming Controls	6.2	128	0.0017	0.0350	720	400	20.0	413	2,321	1,290	4	0.001093	13
Water Heater Timers	0.112	2	0.0000	0.0006	40	18	0.4	7	129	58	1	0.000273	3
Water Heater Insulation	1.17	24	0.0003	0.0068	25	18	3.8	78	81	58	1	0.000273	3

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ECO	ECO Savings		Average Study Blg Savings		Average Study Blg Cost		Average Group Savings		Average Group Cost		No. of Units Per Study Bldg	Units per Study Blg Floor Area	Total Units Per Group
Subgroup B-1- Study Blg 174	MBtu/Yr	$/Yr	MBtu/ft**2	$/Yr/ft**2	Materials $/ft**2	Labor $/ft**2	MBtu/Yr	$/Yr	Materials $	Labor $			
Low Flow Shower Heads	37.2	769	0.0078	0.1602	150	42	417.1	8,622	1,682	471	6	0.00125	67
Compact Fluorescent Lighting	41.9	866	0.0087	0.1804	322	7	469.8	9,711	3,610	78	14	0.002917	157
Occupancy Sensors	55.4	1,145	0.0115	0.2386	1078	98	621.2	12,840	12,087	1,099	14	0.002917	157
Water Heater Timer	1.13	23	0.0002	0.0049	40	18	12.7	262	449	202	1	0.000208	11
Energy Savings Fluorescent Lamps	19.6	405	0.0041	0.0844	490	213	219.8	4,543	5,494	2,388	142	0.029583	1,592
F32 T-8 Lighting System	12	246	0.0025	0.0517	2904	726	134.6	2,781	32,561	8,140	33	0.006875	370
Water Heater Insulation	1.17	24	0.0002	0.0050	25	18	13.1	271	280	202	1	0.000208	18

ECO	ECO Savings		Average Study Blg Savings		Average Study Blg Cost		Average Group Savings		Average Group Cost		No. of Units Per Study Bldg	Units per Study Blg Floor Area	Total Units Per Group
Subgroup D-1- Study Blg 172	MBtu/Yr	$/Yr	MBtu/ft**2	$/Yr/ft**2	Materials $	Labor $	MBtu/Yr	$/Yr	Materials $	Labor $			
Compact Fluorescent Lights	4.12	85	0.0010	0.0199	142	3	4.1	85	142.00	3.00	6	0.001404	6
Energy Savings Fluorescent Lamps	3.68	76	0.0009	0.0178	131	57	3.7	76	131.00	57.00	38	0.008895	38
Occupancy Sensors	15.46	320	0.0036	0.0748	1213	284	15.5	320	1,213.00	284.00	15	0.003511	15
Exit Sign Retrofit	14.06	291	0.0033	0.0681	1375	275	14.1	291	1,375.00	275.00	11	0.002575	11
Water Heater Timers	0.5	10	0.0001	0.0024	40	18	0.5	10	40.00	18.00	1	0.000234	1
DayLight Dimming Controls	0.56	12	0.0001	0.0027	180	100	0.6	12	180.00	100.00	1	0.000234	1

ECO	ECO Savings		Average Study Blg Savings		Average Study Blg Cost		Average Group Savings		Average Group Cost		No. of Units Per Study Bldg	Units per Study Blg Floor Area	Total Units Per Group
Subgroup E-2 Latrines	MBtu/Yr	$/Yr	MBtu/ft**2	$/Yr/ft**2	Materials $	Labor $	MBtu/Yr	$/Yr	Materials $	Labor $			
Compact Flourescent Lights	6.38	132	0.0446	0.9222	23	2	175.4	3,625	632.28	54.98	4	0.027972	119
Occupancy Sensors	2.12	44	0.0148	0.3064	154	14	58.3	1,205	4,233.38	384.85	2	0.013986	60

New Buildings List- Buildings built after 1985 Fort A.P. Hill

SUBGROUP A-1

Bldg. No	Description		Floor Area (Ft**2)
1247	Entomology Facility		1,800
1252	General Inst. Bldg		5,000
1253	Range Control Bldg		5,000
		TOTAL	11,800

SUBGROUP B-1

Bldg. No	Description		Floor Area (Ft**2)
174	Guest House		4,800
290	Log Cabin Bullocks Lake		1,056
1350	FH NCO & ENL, QTRS 8		7,256
1351	FH NCO & ENL, QTRS 6		7,256
1352	FH NCO & ENL, QTRS 4		7,256
1353	FH NCO & ENL, QTRS 2		3,804
1354	FH Colonel, QTRS 1		2,553
1355	CO Grade & WO, QTRS 3		4,846
1356	FH NCO & ENL, QTRS 5		7,737
1357	FH NCO & ENL, QTRS 7		7,256
		TOTAL	53,820

SUBGROUP D-1

Bldg. No	Description		Floor Area (Ft**2)
172	Open Dinning NCO		4,272
		TOTAL	4,272

SUBGROUP E-1

Bldg. No	Description		Floor Area (Ft**2)
1241	Detached Latrine/Shwr		533

SUBGROUP E-2

Bldg. No	Description		Floor Area (Ft**2)
412	Detached Latrine TA12		143
413	Detached Latrine TA12		143
529	Detached Latrine Area 15		90
531	Detached Latrine TA15		143
733	Detached Latrine TNG 18		90
745	Detached Latrine TNG 14		144
746	Detached Latrine Rapp. Compound		144
748	Detached Latrine TA 18		143
826	Detached Latrine Range 42		143
828	Detached Latrine TNG 28		144
839	Detached Latrine at Repell. Twr		143
924	Detached Latrine		108
928	Detached Latrine		144
1008	Detached Latrine- Range 25		143
1024	Detached Latrine-Range 24		144
1108	Detached Latrine-Range 28P		144
1109	Detached Latrine-Range 28P		144
1110	Detached Latrine-Range 28P		144
1114	Detached Latrine		144
1116	Detached Latrine-Range 33		143
1202	Detached Latrine- Range 7		143
1254	Detached Latrine-Range 37		143
1256	Detached Latrine		108
1263	Detached Latrine-Range 6		143
1403	Detached Latrine-Tr Area 5		90
1405	Detached Latrine-Tr Area 3		90
1428	Detached Latrine-Tr Area 3		144
1619	Detached Latrine-Tr Area 21		90
1670	Detached Latrine-Tr Area 21		144
S 1272	Detached Latrine- Range 33		108
		TOTAL	3,931

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LIFE CYCLE COST ANALYSIS SUMMARY
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)

LOCATION: Fort A.P. Hill, Virginia REGION: 3 PROJECT NO.: DACA 31-89-C-0198
PROJECT TITLE: Fort A.P. Hill- Energy Engineering Analysis Program FISCAL YEAR: 1994
DISCRETE PORTION NAME: Energy Saving Fluorescent Lamps
ANALYSIS DATE: January 1994 ECONOMIC LIFE (YRS 15 PREPARER: JJS

1. INVESTMENT COSTS:

A. CONSTRUCTION COST	$	14,665	
B. SIOH	$	807	
C. DESIGN COST	$	880	
D. TOTAL COST (1A+1B+1C)	$	16,351	
E. SALVAGE VALUE OF EXISTING EQUIPMENT			
F. PUBLIC UTILITY COMPANY REBATE			
G. TOTAL INVESTMENT (1D-1E-1F)			$16,351

2. ENERGY SAVINGS (+)/COST(-):

DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS- Oct 1992

ENERGY SOURCE	COST $/MBTU(1)	SAVING(S) MBTU/YR(2)		ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)		DISCOUNTED SAVINGS(5)
A. ELEC	$20.67	297.0	$	6,139	11.77	$	72,256
B. DIST	$5.69		$			$	
C. RESID			$			$	
D. NG			$			$	
E. LPG	$7.76		$			$	
F. COAL			$			$	
G. SOLAR			$			$	
H. GEOTH			$			$	
I. BIOMA			$			$	
J. REFUS			$			$	
K. WIND			$			$	
L. OTHER			$			$	
M. DEMAND SAVINGS			$			$	
N. TOTAL		297	$	6,139		$	72,256

3. NON ENERGY SAVINGS (+) OR COST (-):

A. ANNUAL RECURRING (+/-)
(1) DISCOUNT FACTOR (TABLE A)
(2) DISCOUNTED SAVINGS/COST (3A X 3A1)

B. NON RECURRING SAVINGS (+) OR COST (-)

ITEM		SAVINGS(+) COST(-)(1)	YEAR OF OCCUR. (2)	DISCOUNT FACTOR(3)		DISCOUNTED SAV-INGS(+)COST(-)(4)
a.	$				$	
b.	$				$	
c.	$				$	
d. TOTAL					$	

C. TOTAL NON ENERGY DISCOUNTED SAVINGS (3A2+3Bd4)

4. SIMPLE PAYBACK 1G/(2N3+3A+(3Bd1/ECONOMIC LIFE)):	2.66 YEARS
5. TOTAL NET DISCOUNTED SAVINGS (2N5+3C):	$72,256
6. SAVINGS TO INVESTMENT RATION (SIR) 5/1G:	4.42
7. ADJUSTED INTERNAL RATE OF RETURN (AIRR):	10.83%

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CONSTRUCTION COST ESTIMATE	PREPARED: March 1994	SHEET 1 OF 2
PROJECT: Energy Savings Oppurtunity Survey	CONTRACT NO.: DACA 31-89-C-0198	
LOCATION: Fort A.P. Hill, Virginia		
AE PROJECT NO.: 92008	ESTIMATOR: JS	PRELIM:
AE: Engineering Applications Consultants, P.C.	CHECKED BY: VP	FINAL: X

SUMMARY: Energy Saving Fluor. Lamps

ITEM	QUANTITY		MATERIAL		LABOR		TOTAL
	NO.	MEAS	UNIT	COST	UNIT	COST	COST
Install 35 Watt Energy Saving Fluor. Lamps							
SUBGROUP							
Administration Buildings	464	EA	3.45	1,601	1.50	696	2,297
Dinning Facilities	38	EA	3.45	131	1.50	57	188
Housing Facilities	1592	EA	3.45	5,492	1.50	2,388	7,880
SUB-TOTAL				7,224		3,141	10,365

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CONSTRUCTION COST ESTIMATE	PREPARED: March 1994	SHEET 2 OF 2
PROJECT: Energy Savings Oppurtunity Survey	CONTRACT NO.: DACA 31-89-C-0198	
LOCATION: Fort A.P. Hill, Virginia AE PROJECT NO.: AE: Engineering Applications Consultants, P.C.	ESTIMATOR: JS CHECKED BY: VP	PRELIM: FINAL: X

SUMMARY: Energy Saving Fluor. Lamps

ITEM	QUANTITY		MATERIAL		LABOR		TOTAL COST
	NO.	MEAS	UNIT	COST	UNIT	COST	
SUBTOTAL PREV. PAGE				7,224		3,141	10,365
MARK-UP ON LABOR SUB-TOTAL	21.0%			----		660	660 11,025
TAXES ON MATERIAL SUB-TOTAL	5.0%			361		----	361 11,386
OVERHEAD SUB-TOTAL	15.0%						1,708 13,094
PROFIT SUB-TOTAL	12.0%						1,571 14,665
PRIME MARK-UP ON SUB SUB-TOTAL							14,665
GRAND TOTAL							14,700

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ECO Summary: Energy Saving Fluorescent Lamps

STUDY BUILDING	Floor Area (Ft**2)	Existing Energy Usage MBtu/Yr	$/Yr	Total Energy Savings MBtu/Yr	$/Yr
172	4,272	438	3,400	4	76
174	4,800	379	7,828	20	405
1253	5,000	281	5,802	23	471

Sub Group	Study Bldg.	Applied Subgroup (Ft**2)	Average Study Building Savings MBtu/Ft**2-Yr	$/Ft**2-Yr		Total Applied Group Savings MBtu/Yr	$/Yr
Admin	1253	11,800	0.0062	0.1288		74	1,519
Housing	174	53,820	0.0041	0.0844		220	4,543
Dining	172	4,272	0.0009	0.0178		4	76
					TOTAL	296.95	6,138.02

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Building Number	Dinning 172	Housing 174	Admin 1,253	Field Latrines 412
Floor Area (Ft**2)	4,272	4,800	5,000	143
Group Floor Area (Ft**2)	4,272	53,820	11,800	3,931

Existing Energy Usage- Bldg 1253	
MBtu/Yr	280.7
$/Yr	5,802

Existing Energy Usage- Bldg 174	
MBtu/Yr	378.7
$/Yr	7,828

Existing Energy Usage- Bldg 172	
MBtu/Yr	438.1
$/Yr	3,400

Energy Costs	($/MMBTU)
Electricity	20.67
Fuel Oil	5.69
LP Gas	7.76

ECO	ECO Savings		Average Study Blg Savings		Average Study Blg Cost		Average Group Savings		Average Group Cost		No. of Units Per Study Bldg	Units per Study Blg Floor Area	Total Units Per Group
Subgroup A-1- Study Blg 1253	MBtu/Yr	$/Yr	MBtu/ft**2	$/Yr/ft**2	Materials $	Labor $	MBtu/Yr	$/Yr	Materials $	Labor $			
Low Flow Shower Heads	11.2	232	0.0031	0.0633	25	7	36.1	746	81	23	1	0.000273	3
Occupancy Sensors	31	641	0.0085	0.1751	616	56	99.9	2,066	1,986	181	8	0.002186	26
Compact Fluorescent Lights	6.93	143	0.0019	0.0391	192	4	22.3	462	619	13	8	0.002186	26
Energy Saving Fluorescent Lamps	22.8	471	0.0062	0.1288	497	216	73.5	1,519	1,602	696	144	0.039344	464
Exit Signs	5.38	111	0.0015	0.0304	500	100	17.3	359	1,612	322	4	0.001093	13
F32 T-8 Lighting System	39.7	821	0.0108	0.2242	2317	607	128.0	2,646	7,470	1,957	53	0.014481	171
Economizer Controls	24	496	0.0066	0.1355	2258	1280	77.4	1,599	7,280	4,127	1	0.000273	3
Daylight Dimming Controls	6.2	128	0.0017	0.0350	720	400	20.0	413	2,321	1,290	4	0.001093	13
Water Heater Timers	0.112	2	0.0000	0.0006	40	18	0.4	7	129	58	1	0.000273	3
Water Heater Insulation	1.17	24	0.0003	0.0066	25	18	3.8	78	81	58	1	0.000273	3

ECO	ECO Savings		Average Study Blg Savings		Average Study Blg Cost		Average Group Savings		Average Group Cost		No. of Units Per Study Bldg	Units per Study Blg Floor Area	Total Units Per Group
Subgroup B-1- Study Blg 174	MBtu/Yr	$/Yr	MBtu/ft**2	$/Yr/ft**2	Materials $/ft**2	Labor $/ft**2	MBtu/Yr	$/Yr	Materials $	Labor $			
Low Flow Shower Heads	37.2	769	0.0078	0.1602	150	42	417.1	8,622	1,682	471	6	0.00125	67
Compact Fluorescent Lighting	41.9	866	0.0087	0.1804	322	7	469.8	9,711	3,610	78	14	0.002917	157
Occupancy Sensors	55.4	1,145	0.0115	0.2386	1078	98	621.2	12,840	12,087	1,099	14	0.002917	157
Water Heater Timer	1.13	23	0.0002	0.0049	40	18	12.7	262	449	202	1	0.000208	11
Energy Savings Fluorescent Lamps	19.6	405	0.0041	0.0844	490	213	219.8	4,543	5,494	2,388	142	0.029583	1,592
F32 T-8 Lighting System	12	248	0.0025	0.0517	2904	726	134.6	2,781	32,561	8,140	33	0.006875	370
Water Heater Insulation	1.17	24	0.0002	0.0050	25	18	13.1	271	280	202	1	0.000208	18

ECO	ECO Savings		Average Study Blg Savings		Average Study Blg Cost		Average Group Savings		Average Group Cost		No. of Units Per Study Bldg	Units per Study Blg Floor Area	Total Units Per Group
Subgroup D-1- Study Blg 172	MBtu/Yr	$/Yr	MBtu/ft**2	$/Yr/ft**2	Materials $	Labor $	MBtu/Yr	$/Yr	Materials $	Labor $			
Compact Fluorescent Lights	4.12	85	0.0010	0.0199	142	3	4.1	85	142.00	3.00	6	0.001404	6
Energy Savings Fluorescent Lamps	3.68	76	0.0009	0.0178	131	57	3.7	76	131.00	57.00	38	0.008895	38
Occupancy Sensors	15.46	320	0.0036	0.0748	1213	284	15.5	320	1,213.00	284.00	15	0.003511	15
Exit Sign Retrofit	14.08	291	0.0033	0.0681	1375	275	14.1	291	1,375.00	275.00	11	0.002575	11
Water Heater Timers	0.5	10	0.0001	0.0024	40	18	0.5	10	40.00	18.00	1	0.000234	1
DayLight Dimming Controls	0.58	12	0.0001	0.0027	180	100	0.6	12	180.00	100.00	1	0.000234	1

ECO	ECO Savings		Average Study Blg Savings		Average Study Blg Cost		Average Group Savings		Average Group Cost		No. of Units Per Study Bldg	Units per Study Blg Floor Area	Total Units Per Group
Subgroup E-2 Latrines	MBtu/Yr	$/Yr	MBtu/ft**2	$/Yr/ft**2	Materials $	Labor $	MBtu/Yr	$/Yr	Materials $	Labor $			
Compact Flourescent Lights	6.38	132	0.0446	0.9222	23	2	175.4	3,625	632.26	54.98	4	0.027972	119
Occupancy Sensors	2.12	44	0.0148	0.3064	154	14	58.3	1,205	4,233.38	384.85	2	0.013986	60

New Buildings List- Buildings built after 1985 Fort A.P. Hill

SUBGROUP A-1

Bldg. No	Description		Floor Area (Ft**2)
1247	Entomology Facility		1,800
1252	General Inst. Bldg		5,000
1253	Range Control Bldg		5,000
		TOTAL	11,800

SUBGROUP B-1

Bldg. No	Description		Floor Area (Ft**2)
174	Guest House		4,800
290	Log Cabin Bullocks Lake		1,056
1350	FH NCO & ENL, QTRS 8		7,256
1351	FH NCO & ENL, QTRS 6		7,256
1352	FH NCO & ENL, QTRS 4		7,256
1353	FH NCO & ENL, QTRS 2		3,804
1354	FH Colonel, QTRS 1		2,553
1355	CO Grade & WO, QTRS 3		4,846
1356	FH NCO & ENL, QTRS 5		7,737
1357	FH NCO & ENL, QTRS 7		7,256
		TOTAL	53,820

SUBGROUP D-1

Bldg. No	Description		Floor Area (Ft**2)
172	Open Dinning NCO		4,272
		TOTAL	4,272

SUBGROUP E-1

Bldg. No	Description		Floor Area (Ft**2)
1241	Detached Latrine/Shwr		533

SUBGROUP E-2

Bldg. No	Description		Floor Area (Ft**2)
412	Detached Latrine TA12		143
413	Detached Latrine TA12		143
529	Detached Latrine Area 15		90
531	Detached Latrine TA15		143
733	Detached Latrine TNG 18		90
745	Detached Latrine TNG 14		144
746	Detached Latrine Rapp. Compound		144
748	Detached Latrine TA 18		143
826	Detached Latrine Range 42		143
828	Detached Latrine TNG 28		144
839	Detached Latrine at Repell. Twr		143
924	Detached Latrine		108
928	Detached Latrine		144
1008	Detached Latrine- Range 25		143
1024	Detached Latrine-Range 24		144
1108	Detached Latrine-Range 28P		144
1109	Detached Latrine-Range 28P		144
1110	Detached Latrine-Range 28P		144
1114	Detached Latrine		144
1116	Detached Latrine-Range 33		143
1202	Detached Latrine- Range 7		143
1254	Detached Latrine-Range 37		143
1256	Detached Latrine		108
1263	Detached Latrine-Range 6		143
1403	Detached Latrine-Tr Area 5		90
1405	Detached Latrine-Tr Area 3		90
1428	Detached Latrine-Tr Area 3		144
1619	Detached Latrine-Tr Area 21		90
1670	Detached Latrine-Tr Area 21		144
S 1272	Detached Latrine- Range 33		108
		TOTAL	3,931

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LIFE CYCLE COST ANALYSIS SUMMARY
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)

LOCATION: Fort A.P. Hill, Virginia REGION: 3 PROJECT NO.: DACA 31-89-C-0198
PROJECT TITLE: Fort A.P. Hill- Energy Engineering Analysis Program FISCAL YEAR: 1994
DISCRETE PORTION NAME: Shut Down Energy To Hotwater Heaters or Modify Controls
ANALYSIS DATE: January 1994 ECONOMIC LIFE (YRS 20 PREPARER: JJS

1. INVESTMENT COSTS:

A. CONSTRUCTION COST	$	908	
B. SIOH	$	50	
C. DESIGN COST	$	54	
D. TOTAL COST (1A+1B+1C)	$	1,012	
E. SALVAGE VALUE OF EXISTING EQUIPMENT			
F. PUBLIC UTILITY COMPANY REBATE			
G. TOTAL INVESTMENT (1D-1E-1F)			$1,012

2. ENERGY SAVINGS (+)/COST(-):

DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS- Oct 1992

ENERGY SOURCE	COST $/MBTU(1)	SAVING(S) MBTU/YR(2)	ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELEC	$20.67	13.0	$ 269	14.65	$ 3,937
B. DIST	$5.69		$		$
C. RESID			$		$
D. NG			$		$
E. LPG	$7.76		$		$
F. COAL			$		$
G. SOLAR			$		$
H. GEOTH			$		$
I. BIOMA			$		$
J. REFUS			$		$
K. WIND			$		$
L. OTHER			$		$
M. DEMAND SAVINGS			$		$
N. TOTAL		13	$ 269		$ 3,937

3. NON ENERGY SAVINGS (+) OR COST (-):

A. ANNUAL RECURRING (+/-)
(1) DISCOUNT FACTOR (TABLE A)
(2) DISCOUNTED SAVINGS/COST (3A X 3A1)

B. NON RECURRING SAVINGS (+) OR COST (-)

ITEM	SAVINGS(+) COST(-)(1)	YEAR OF OCCUR. (2)	DISCOUNT FACTOR(3)	DISCOUNTED SAV-INGS(+)COST(-)(4)
a.	$			$
b.	$			$
c.	$			$
d. TOTAL				$

C. TOTAL NON ENERGY DISCOUNTED SAVINGS (3A2+3Bd4)

4. SIMPLE PAYBACK 1G/(2N3+3A+(3Bd1/ECONOMIC LIFE)):	3.77 YEARS
5. TOTAL NET DISCOUNTED SAVINGS (2N5+3C):	$3,937
6. SAVINGS TO INVESTMENT RATION (SIR) 5/1G:	3.89
7. ADJUSTED INTERNAL RATE OF RETURN (AIRR):	7.31%

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CONSTRUCTION COST ESTIMATE

PREPARED: March 1994

PROJECT: Energy Savings Oppurtunity Survey

CONTRACT NO.: DACA 31-89-C-0198

LOCATION: Fort A.P. Hill, Virginia
AE PROJECT NO.: 92008
AE: Engineering Applications Consultants, P.C.

ESTIMATOR: JS
CHECKED BY: VP

PRELIM:
FINAL: X

SUMMARY: Shut Down Energy to Hotwater Heaters or Modify Controls

ITEM	QUANTITY		MATERIAL		LABOR		TOTAL COST
	NO.	MEAS	UNIT	COST	UNIT	COST	
Water Heater Timers							
SUBGROUP							
Housing Facilities	11	EA	40.00	440	18.25	201	641
SUB-TOTAL				440		201	641

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CONSTRUCTION COST ESTIMATE	PREPARED: March 1994 SHEET 2 OF 2
PROJECT: Energy Savings Oppurtunity Survey LOCATION: Fort A.P. Hill, Virginia AE PROJECT NO.: AE: Engineering Applications Consultants, P.C.	CONTRACT NO.: DACA 31-89-C-0198 ESTIMATOR: JS PRELIM: CHECKED BY: VP FINAL: X

SUMMARY: Shut Down Energy to Hotwater Heaters or Modify Controls

ITEM	QUANTITY		MATERIAL		LABOR		TOTAL COST
	NO.	MEAS	UNIT	COST	UNIT	COST	
SUBTOTAL PREV. PAGE				440		201	641
MARK-UP ON LABOR SUB-TOTAL	21.0%			----		42	42 683
TAXES ON MATERIAL SUB-TOTAL	5.0%			22		----	22 705
OVERHEAD SUB-TOTAL	15.0%						106 811
PROFIT SUB-TOTAL	12.0%						97 908
PRIME MARK-UP ON SUB SUB-TOTAL							908
GRAND TOTAL							900

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ECO Summary: Shut Down Energy To Hot Water Heaters or Modify Controls

STUDY BUILDING	Floor Area (Ft**2)	Existing Energy Usage MBtu/Yr	Existing Energy Usage $/Yr	Total Energy Savings MBtu/Yr	Total Energy Savings $/Yr
172	4,272	438	3,400	0.0	0.0
174	4,800	379	7,828	1.1	23.4
1253	5,000	281	5,802	0.0	0.0

Sub Group	Study Bldg.	Applied Subgroup (Ft**2)	Average Study Building Savings MBtu/Ft**2-Yr	Average Study Building Savings $/Ft**2-Yr		Total Applied Group Savings MBtu/Yr	Total Applied Group Savings $/Yr
Admin	1253	11,800	0.0000	0.0000		0	0
Housing	174	53,820	0.0002	0.0049		13	262
Dining	172	4,272	0.0000	0.0000		0	0
					TOTAL	12.7	261.89

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	Dinning	Housing	Admin	Field Latrines
Building Number	172	174	1,253	412
Floor Area (Ft**2)	4,272	4,800	5,000	143
Group Floor Area (Ft**2)	4,272	53,820	11,800	3,931

Existing Energy Usage- Bldg 1253	
MBtu/Yr	280.7
$/Yr	5,802

Existing Energy Usage- Bldg 174	
MBtu/Yr	378.7
$/Yr	7,828

Existing Energy Usage- Bldg 172	
MBtu/Yr	438.1
$/Yr	3,400

Energy Costs ($/MMBTU)	
Electricity	20.67
Fuel Oil	5.69
LP Gas	7.76

ECO	ECO Savings		Average Study Blg Savings		Average Study Blg Cost		Average Group Savings		Average Group Cost		No. of Units Per Study Bldg	Units per Study Blg Floor Area	Total Units Per Group
Subgroup A-1- Study Blg 1253	MBtu/Yr	$/Yr	MBtu/ft**2	$/Yr/ft**2	Materials $	Labor $	MBtu/Yr	$/Yr	Materials $	Labor $			
Low Flow Shower Heads	11.2	232	0.0031	0.0633	25	7	36.1	746	81	23	1	0.000273	3
Occupancy Sensors	31	641	0.0085	0.1751	616	56	99.9	2,066	1,986	181	8	0.002186	26
Compact Fluorescent Lights	6.93	143	0.0019	0.0391	192	4	22.3	462	619	13	8	0.002186	26
Energy Saving Fluorescent Lamps	22.8	471	0.0062	0.1288	497	216	73.5	1,519	1,602	696	144	0.039344	464
Exit Signs	5.38	111	0.0015	0.0304	500	100	17.3	359	1,612	322	4	0.001093	13
F32 T-8 Lighting System	39.7	821	0.0108	0.2242	2317	607	128.0	2,646	7,470	1,957	53	0.014481	171
Economizer Controls	24	496	0.0066	0.1355	2258	1280	77.4	1,599	7,280	4,127	1	0.000273	3
Daylight Dimming Controls	6.2	128	0.0017	0.0350	720	400	20.0	413	2,321	1,290	4	0.001093	13
Water Heater Timers	0.112	2	0.0000	0.0006	40	18	0.4	7	129	58	1	0.000273	3
Water Heater Insulation	1.17	24	0.0003	0.0066	25	18	3.8	78	81	58	1	0.000273	3

ECO	ECO Savings		Average Study Blg Savings		Average Study Blg Cost		Average Group Savings		Average Group Cost		No. of Units Per Study Bldg	Units per Study Blg Floor Area	Total Units Per Group
Subgroup B-1- Study Blg 174	MBtu/Yr	$/Yr	MBtu/ft**2	$/Yr/ft**2	Materials $/ft**2	Labor $/ft**2	MBtu/Yr	$/Yr	Materials $	Labor $			
Low Flow Shower Heads	37.2	769	0.0078	0.1602	150	42	417.1	8,622	1,682	471	6	0.00125	67
Compact Fluorescent Lighting	41.9	866	0.0087	0.1804	322	7	469.8	9,711	3,610	78	14	0.002917	157
Occupancy Sensors	55.4	1,145	0.0115	0.2386	1076	98	621.2	12,840	12,087	1,099	14	0.002917	157
Water Heater Timer	1.13	23	0.0002	0.0049	40	18	12.7	262	449	202	1	0.000208	11
Energy Savings Fluorescent Lamps	19.6	405	0.0041	0.0844	490	213	219.8	4,543	5,494	2,388	142	0.029583	1,592
F32 T-8 Lighting System	12	248	0.0025	0.0517	2904	726	134.8	2,781	32,561	8,140	33	0.006875	370
Water Heater Insulation	1.17	24	0.0002	0.0050	25	18	13.1	271	280	202	1	0.000208	18

ECO	ECO Savings		Average Study Blg Savings		Average Study Blg Cost		Average Group Savings		Average Group Cost		No. of Units Per Study Bldg	Units per Study Blg Floor Area	Total Units Per Group
Subgroup D-1- Study Blg 172	MBtu/Yr	$/Yr	MBtu/ft**2	$/Yr/ft**2	Materials $	Labor $	MBtu/Yr	$/Yr	Materials $	Labor $			
Compact Fluorescent Lights	4.12	85	0.0010	0.0199	142	3	4.1	85	142.00	3.00	6	0.001404	6
Energy Savings Fluorescent Lamps	3.68	76	0.0009	0.0178	131	57	3.7	76	131.00	57.00	38	0.008895	38
Occupancy Sensors	15.48	320	0.0036	0.0748	1213	284	15.5	320	1,213.00	284.00	15	0.003511	15
Exit Sign Retrofit	14.08	291	0.0033	0.0681	1375	275	14.1	291	1,375.00	275.00	11	0.002575	11
Water Heater Timers	0.5	10	0.0001	0.0024	40	18	0.5	10	40.00	18.00	1	0.000234	1
DayLight Dimming Controls	0.58	12	0.0001	0.0027	180	100	0.6	12	180.00	100.00	1	0.000234	1

ECO	ECO Savings		Average Study Blg Savings		Average Study Blg Cost		Average Group Savings		Average Group Cost		No. of Units Per Study Bldg	Units per Study Blg Floor Area	Total Units Per Group
Subgroup E-2 Latrines	MBtu/Yr	$/Yr	MBtu/ft**2	$/Yr/ft**2	Materials $	Labor $	MBtu/Yr	$/Yr	Materials $	Labor $			
Compact Flourescent Lights	6.38	132	0.0446	0.9222	23	2	175.4	3,625	632.26	54.96	4	0.027972	119
Occupancy Sensors	2.12	44	0.0148	0.3064	154	14	58.3	1,205	4,233.38	384.85	2	0.013986	60

SUBGROUP B-1

Bldg. No	Description		Floor Area (Ft**2)
174	Guest House		4,800
290	Log Cabin Bullocks Lake		1,056
1350	FH NCO & ENL, QTRS 8		7,256
1351	FH NCO & ENL, QTRS 6		7,256
1352	FH NCO & ENL, QTRS 4		7,256
1353	FH NCO & ENL, QTRS 2		3,804
1354	FH Colonel, QTRS 1		2,553
1355	CO Grade & WO, QTRS 3		4,846
1356	FH NCO & ENL, QTRS 5		7,737
1357	FH NCO & ENL, QTRS 7		7,256
		TOTAL	53,820

LIFE CYCLE COST ANALYSIS SUMMARY
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)

LOCATION: Fort A.P. Hill, Virginia REGION: 3 PROJECT NO.: DACA 31-89-C-0198
PROJECT TITLE: Fort A.P. Hill- Energy Engineering Analysis Program FISCAL YEAR: 1994
DISCRETE PORTION NAME: Exit Sign Replacement
ANALYSIS DATE: January 1994 ECONOMIC LIFE (YRS 15 PREPARER: JJS

1. INVESTMENT COSTS:

A. CONSTRUCTION COST	$	4,992	
B. SIOH	$	275	
C. DESIGN COST	$	300	
D. TOTAL COST (1A+1B+1C)	$	5,566	
E. SALVAGE VALUE OF EXISTING EQUIPMENT			
F. PUBLIC UTILITY COMPANY REBATE			
G. TOTAL INVESTMENT (1D-1E-1F)			$5,566

2. ENERGY SAVINGS (+)/COST(-):

DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS- Oct 1992

ENERGY SOURCE	COST $/MBTU(1)	SAVING(S) MBTU/YR(2)	ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELEC	$20.67	31.0	$ 641	11.77	$ 7,542
B. DIST	$5.69		$		$
C. RESID			$		$
D. NG			$		$
E. LPG	$7.76		$		$
F. COAL			$		$
G. SOLAR			$		$
H. GEOTH			$		$
I. BIOMA			$		$
J. REFUS			$		$
K. WIND			$		$
L. OTHER			$		$
M. DEMAND SAVINGS			$		$
N. TOTAL		31	$ 641		$ 7,542

3. NON ENERGY SAVINGS (+) OR COST (-):

A. ANNUAL RECURRING (+/-)	$454		
(1) DISCOUNT FACTOR (TABLE A)		11.12	
(2) DISCOUNTED SAVINGS/COST (3A X 3A1)			$5,048

B. NON RECURRING SAVINGS (+) OR COST (-)

ITEM	SAVINGS(+) COST(-)(1)	YEAR OF OCCUR. (2)	DISCOUNT FACTOR(3)	DISCOUNTED SAVINGS(+)COST(-)(4)
a.	$			$
b.	$			$
c.	$			$
d. TOTAL				$

C. TOTAL NON ENERGY DISCOUNTED SAVINGS (3A2+3Bd4) $5,048

4. SIMPLE PAYBACK 1G/(2N3+3A+(3Bd1/ECONOMIC LIFE)): 5.08 YEARS
5. TOTAL NET DISCOUNTED SAVINGS (2N5+3C): $12,590
6. SAVINGS TO INVESTMENT RATION (SIR) 5/1G: 2.26
7. ADJUSTED INTERNAL RATE OF RETURN (AIRR): 5.82%

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Engineering
Applications
Consultants

A Professional
Corporation

9004-B Crownwood Ct.
Burke, Virginia 22015-1630
(703) 978-0923

ENGINEERING ANALYSIS

Sheet ____ of ____

By: JS

EXIT SIGN RETROFIT

Project: Fort A. P. Hill ESOS

Date: 2-28-94

Contract No.: DACA 31-89-C-0198

EAC Project No.: 92008

LAMP Economical life over 15 YRS

25W INCANDESCENT LAMP LIFE = 3000 hrs
(EXIT sign LAMPS GE p. 13)

6 WATT LED Life = 30 yrs ∴ USE 15 YRS (LIFE OF PROJECT)

$$\frac{3000 \text{ hrs}}{8760 \text{ hrs/yr}} = .34 \text{ YRS}$$ (USE 4 MOS. PER LAMP LIFE)

= 3 changes PER YR

$$48 \text{ LAMPS} \times \frac{3 \text{ changes}}{\text{yr}} \times \frac{\$3.15}{\text{change}} = \$453.60 \cong \$454$$

574

CONSTRUCTION COST ESTIMATE	PREPARED: March 1994	SHEET 1 OF 2
PROJECT: Energy Savings Oppurtunity Survey LOCATION: Fort A.P. Hill, Virginia AE PROJECT NO.: 92008 AE: Engineering Applications Consultants, P.C.	CONTRACT NO.: DACA 31-89-C-0198 ESTIMATOR: JS CHECKED BY: VP	 PRELIM: FINAL: X

SUMMARY: Exit Sign Retrofit

ITEM	QUANTITY		MATERIAL		LABOR		TOTAL COST
	NO.	MEAS	UNIT	COST	UNIT	COST	
Battery Backup LED Exit Sign Replacement Fixtures							
SUBGROUP							
Administration Buildings	13	EA	125.00	1,625	25.00	325	1,950
Dinning Facilities	11	EA	125.00	1,375	25.00	275	1,650
Housing Facilities		EA	125.00		25.00		
SUB-TOTAL				3,000		600	3,600

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575

CONSTRUCTION COST ESTIMATE	PREPARED: March 1994	SHEET 2 OF 2
PROJECT: Energy Savings Oppurtunity Survey LOCATION: Fort A.P. Hill, Virginia AE PROJECT NO.: AE: Engineering Applications Consultants, P.C.	CONTRACT NO.: DACA 31-89-C-0198 ESTIMATOR: JS CHECKED BY: VP	PRELIM: FINAL: X

SUMMARY: Exit Sign Retrofit

ITEM	QUANTITY		MATERIAL		LABOR		TOTAL
	NO.	MEAS	UNIT	COST	UNIT	COST	COST
SUBTOTAL PREV. PAGE				3,000		600	3,600
MARK-UP ON LABOR SUB-TOTAL	21.0%			----		126	126 3,726
TAXES ON MATERIAL SUB-TOTAL	5.0%			150		----	150 3,876
OVERHEAD SUB-TOTAL	15.0%						581 4,457
PROFIT SUB-TOTAL	12.0%						535 4,992
PRIME MARK-UP ON SUB SUB-TOTAL							4,992
GRAND TOTAL							5,000

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524

ECO Summary: Exit Sign Replacement

STUDY BUILDING	Floor Area (Ft**2)	Existing Energy Usage MBtu/Yr	Existing Energy Usage $/Yr	Total Energy Savings MBtu/Yr	Total Energy Savings $/Yr
172	4,272	438	3,400	14.1	291.0
174	4,800	379	7,828	0.0	0.0
1253	5,000	281	5,802	5.4	111.2

Sub Group	Study Bldg.	Applied Subgroup (Ft**2)	Average Study Building Savings MBtu/Ft**2-Yr	Average Study Building Savings $/Ft**2-Yr		Total Applied Group Savings MBtu/Yr	Total Applied Group Savings $/Yr
Admin	1253	11,800	0.0015	0.0304		17	359
Housing	174	53,820	0.0000	0.0000		0	0
Dining	172	4,272	0.0033	0.0681		14	291
					TOTAL	31.4	649.56

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	Dinning	Housing	Admin	Field Latrines
Building Number	172	174	1,253	412
Floor Area (Ft**2)	4,272	4,800	5,000	143
Group Floor Area (Ft**2)	4,272	53,820	11,800	3,931

Existing Energy Usage- Bldg 1253	
MBtu/Yr	280.7
$/Yr	5,802

Existing Energy Usage- Bldg 174	
MBtu/Yr	378.7
$/Yr	7,828

Existing Energy Usage- Bldg 172	
MBtu/Yr	438.1
$/Yr	3,400

Energy Costs	($/MMBTU)
Electricity	20.67
Fuel Oil	5.69
LP Gas	7.76

ECO	ECO Savings		Average Study Blg Savings		Average Study Blg Cost		Average Group Savings		Average Group Cost		No. of Units Per Study Bldg	Units per Study Blg Floor Area	Total Units Per Group
Subgroup A-1- Study Blg 1253	MBtu/Yr	$/Yr	MBtu/ft**2	$/Yr/ft**2	Materials $	Labor $	MBtu/Yr	$/Yr	Materials $	Labor $			
Low Flow Shower Heads	11.2	232	0.0031	0.0633	25	7	36.1	746	81	23	1	0.000273	3
Occupancy Sensors	31	641	0.0085	0.1751	616	56	99.9	2,066	1,986	181	8	0.002186	26
Compact Fluorescent Lights	6.93	143	0.0019	0.0391	192	4	22.3	462	619	13	8	0.002186	26
Energy Saving Fluorescent Lamps	22.8	471	0.0062	0.1288	497	216	73.5	1,519	1,602	696	144	0.039344	464
Exit Signs	5.38	111	0.0015	0.0304	500	100	17.3	359	1,612	322	4	0.001093	13
F32 T-8 Lighting System	39.7	821	0.0108	0.2242	2317	607	128.0	2,646	7,470	1,957	53	0.014481	171
Economizer Controls	24	496	0.0066	0.1355	2258	1280	77.4	1,599	7,280	4,127	1	0.000273	3
Daylight Dimming Controls	6.2	128	0.0017	0.0350	720	400	20.0	413	2,321	1,290	4	0.001093	13
Water Heater Timers	0.112	2	0.0000	0.0006	40	18	0.4	7	129	58	1	0.000273	3
Water Heater Insulation	1.17	24	0.0003	0.0066	25	18	3.8	78	81	58	1	0.000273	3

ECO Subgroup B-1- Study Blg 174	ECO Savings MBtu/Yr	 $/Yr	Average Study Blg Savings MBtu/ft**2	 $/Yr/ft**2	Average Study Blg Cost Materials $/ft**2	 Labor $/ft**2	Average Group Savings MBtu/Yr	 $/Yr	Average Group Cost Materials $	 Labor $	No. of Units Per Study Bldg	Units per Study Blg Floor Area	Total Units Per Group
Low Flow Shower Heads	37.2	769	0.0078	0.1602	150	42	417.1	8,622	1,682	471	6	0.00125	67
Compact Fluorescent Lighting	41.9	868	0.0087	0.1804	322	7	469.8	9,711	3,610	78	14	0.002917	157
Occupancy Sensors	55.4	1,145	0.0115	0.2386	1078	98	621.2	12,840	12,087	1,099	14	0.002917	157
Water Heater Timer	1.13	23	0.0002	0.0049	40	18	12.7	262	449	202	1	0.000208	11
Energy Savings Fluorescent Lamps	19.8	405	0.0041	0.0844	490	213	219.8	4,543	5,494	2,388	142	0.029583	1,592
F32 T-8 Lighting System	12	248	0.0025	0.0517	2904	728	134.8	2,781	32,561	8,140	33	0.006875	370
Water Heater Insulation	1.17	24	0.0002	0.0050	25	18	13.1	271	280	202	1	0.000208	18

ECO Subgroup D-1- Study Blg 172	ECO Savings MBtu/Yr	 $/Yr	Average Study Blg Savings MBtu/ft**2	 $/Yr/ft**2	Average Study Blg Cost Materials $	 Labor $	Average Group Savings MBtu/Yr	 $/Yr	Average Group Cost Materials $	 Labor $	No. of Units Per Study Bldg	Units per Study Blg Floor Area	Total Units Per Group
Compact Fluorescent Lights	4.12	85	0.0010	0.0199	142	3	4.1	85	142.00	3.00	6	0.001404	6
Energy Savings Fluorescent Lamps	3.68	76	0.0009	0.0178	131	57	3.7	76	131.00	57.00	38	0.008895	38
Occupancy Sensors	15.46	320	0.0036	0.0748	1213	284	15.5	320	1,213.00	284.00	15	0.003511	15
Exit Sign Retrofit	14.06	291	0.0033	0.0681	1375	275	14.1	291	1,375.00	275.00	11	0.002575	11
Water Heater Timers	0.5	10	0.0001	0.0024	40	18	0.5	10	40.00	18.00	1	0.000234	1
DayLight Dimming Controls	0.56	12	0.0001	0.0027	180	100	0.6	12	180.00	100.00	1	0.000234	1

ECO Subgroup E-2 Latrines	ECO Savings MBtu/Yr	 $/Yr	Average Study Blg Savings MBtu/ft**2	 $/Yr/ft**2	Average Study Blg Cost Materials $	 Labor $	Average Group Savings MBtu/Yr	 $/Yr	Average Group Cost Materials $	 Labor $	No. of Units Per Study Bldg	Units per Study Blg Floor Area	Total Units Per Group
Compact Flourescent Lights	6.38	132	0.0446	0.9222	23	2	175.4	3,625	632.28	54.98	4	0.027972	119
Occupancy Sensors	2.12	44	0.0148	0.3064	154	14	58.3	1,205	4,233.38	384.85	2	0.013986	60

New Buildings List- Buildings built after 1985 Fort A.P. Hill

SUBGROUP A-1

Bldg. No	Description		Floor Area (Ft**2)
1247	Entomology Facility		1,800
1252	General Inst. Bldg		5,000
1253	Range Control Bldg		5,000
		TOTAL	11,800

SUBGROUP D-1

Bldg. No	Description		Floor Area (Ft**2)
172	Open Dinning NCO		4,272
		TOTAL	4,272

LIFE CYCLE COST ANALYSIS SUMMARY
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)

LOCATION: Fort A.P. Hill, Virginia REGION: 3 PROJECT NO.: DACA 31-89-C-0198
PROJECT TITLE: Fort A.P. Hill- Energy Engineering Analysis Program FISCAL YEAR: 1994
DISCRETE PORTION NAME: Replace Existing Fluorescent Fixtures with Energy Efficient Fixtures, Ballast and Lamps
ANALYSIS DATE: January 1994 ECONOMIC LIFE (YRS 15 PREPARER: JJS

1. INVESTMENT COSTS:

A. CONSTRUCTION COST	$	14,915	
B. SIOH	$	820	
C. DESIGN COST	$	895	
D. TOTAL COST (1A+1B+1C)	$	16,630	
E. SALVAGE VALUE OF EXISTING EQUIPMENT			
F. PUBLIC UTILITY COMPANY REBATE			
G. TOTAL INVESTMENT (1D-1E-1F)			$16,630

2. ENERGY SAVINGS (+)/COST(-):

DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS- Oct 1992

ENERGY SOURCE	COST $/MBTU(1)	SAVING(S) MBTU/YR(2)	ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELEC	$20.67	128.0	$ 2,646	11.77	$ 31,141
B. DIST	$5.69		$		$
C. RESID			$		$
D. NG			$		$
E. LPG	$7.76		$		$
F. COAL			$		$
G. SOLAR			$		$
H. GEOTH			$		$
I. BIOMA			$		$
J. REFUS			$		$
K. WIND			$		$
L. OTHER			$		$
M. DEMAND SAVINGS			$		$
N. TOTAL		128	$ 2,646		$ 31,141

3. NON ENERGY SAVINGS (+) OR COST (-):

A. ANNUAL RECURRING (+/-)
(1) DISCOUNT FACTOR (TABLE A)
(2) DISCOUNTED SAVINGS/COST (3A X 3A1)

B. NON RECURRING SAVINGS (+) OR COST (-)

ITEM	SAVINGS(+) COST(-)(1)	YEAR OF OCCUR. (2)	DISCOUNT FACTOR(3)	DISCOUNTED SAVINGS(+)COST(-)(4)
a.	$			$
b.	$			$
c.	$			$
d. TOTAL				$

C. TOTAL NON ENERGY DISCOUNTED SAVINGS (3A2+3Bd4)

4. SIMPLE PAYBACK 1G/(2N3+3A+(3Bd1/ECONOMIC LIFE)): 6.29 YEARS
5. TOTAL NET DISCOUNTED SAVINGS (2N5+3C): $31,141
6. SAVINGS TO INVESTMENT RATION (SIR) 5/1G: 1.87
7. ADJUSTED INTERNAL RATE OF RETURN (AIRR): 4.44%

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CONSTRUCTION COST ESTIMATE	PREPARED: March 1994	SHEET 1 OF 2
PROJECT: Energy Savings Oppurtunity Survey LOCATION: Fort A.P. Hill, Virginia AE PROJECT NO.: 92008 AE: Engineering Applications Consultants, P.C.	CONTRACT NO.: DACA 31-89-C-0198 ESTIMATOR: JS CHECKED BY: VP	 PRELIM: FINAL: X

SUMMARY: Replace Existing Fluorescent Fixtures with Energy Efficient Fixtures, Ballast, and Lamps

ITEM	QUANTITY		MATERIAL		LABOR		TOTAL COST
	NO.	MEAS	UNIT	COST	UNIT	COST	
F32T-8 Lighting Retrofit							
SUBGROUP							
Administration Buildings							
F32T-8 Lamps	1	Group	8,430.00	8,430	2,253.00	2,253	10,683
SUB-TOTAL				8,430		2,253	10,683

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CONSTRUCTION COST ESTIMATE	PREPARED: March 1994	SHEET OF
PROJECT: Energy Savings Oppurtunity Survey	CONTRACT NO.: DACA 31-89-C-0198	SHEET 2 OF 2
LOCATION: Fort A.P. Hill, Virginia		
AE PROJECT NO.:	ESTIMATOR: JS	PRELIM:
AE: Engineering Applications Consultants, P.C.	CHECKED BY: VP	FINAL: X

SUMMARY: Replace Existing Fluorescent Fixtures with Energy Efficient Fixtures, Ballast, and Lamps

ITEM	QUANTITY		MATERIAL		LABOR		TOTAL COST
	NO.	MEAS	UNIT	COST	UNIT	COST	
SUBTOTAL PREV. PAGE				8,430		2,253	10,683
MARK-UP ON LABOR SUB-TOTAL	21.0%			---		473	473 11,156
TAXES ON MATERIAL SUB-TOTAL	5.0%			422		---	422 11,578
OVERHEAD SUB-TOTAL	15.0%						1,737 13,314
PROFIT SUB-TOTAL	12.0%						1,598 14,912
PRIME MARK-UP ON SUB SUB-TOTAL							14,912
GRAND TOTAL							14,900

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ECO Summary: Replace Existing Fluorescent Fixtures with Energy Efficient Fixtures, Ballast and

STUDY BUILDING	Floor Area (Ft**2)	Existing Energy Usage MBtu/Yr	$/Yr	Total Energy Savings MBtu/Yr	$/Yr
172	4,272	438	3,400	0.0	0.0
174	4,800	379	7,828	0.0	0.0
1253	5,000	281	5,802	39.7	820.6

Sub Group	Study Bldg.	Applied Subgroup (Ft**2)	Average Study Building Savings MBtu/Ft**2-Yr	$/Ft**2-Yr		Total Applied Group Savings MBtu/Yr	$/Yr
Admin	1253	11,800	0.0108	0.2242		128	2,646
Housing	174	53,820	0.0000	0.0000		0	0
Dining	172	4,272	0.0000	0.0000		0	0
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Building Number	Dinning 172	Housing 174	Admin 1,253	Field Latrines 412
Floor Area (Ft**2)	4,272	4,800	5,000	143
Group Floor Area (Ft**2)	4,272	53,820	11,800	3,931

Existing Energy Usage- Bldg 1253	
MBtu/Yr	280.7
$/Yr	5,802

Existing Energy Usage- Bldg 174	
MBtu/Yr	378.7
$/Yr	7,828

Existing Energy Usage- Bldg 172	
MBtu/Yr	438.1
$/Yr	3,400

Energy Costs	($/MMBTU)
Electricity	20.67
Fuel Oil	5.69
LP Gas	7.76

ECO	ECO Savings		Average Study Blg Savings		Average Study Blg Cost		Average Group Savings		Average Group Cost		No. of Units Per Study Bldg	Units per Study Blg Floor Area	Total Units Per Group
Subgroup A-1- Study Blg 1253	MBtu/Yr	$/Yr	MBtu/ft**2	$/Yr/ft**2	Materials $	Labor $	MBtu/Yr	$/Yr	Materials $	Labor $			
Low Flow Shower Heads	11.2	232	0.0031	0.0633	25	7	36.1	746	81	23	1	0.000273	3
Occupancy Sensors	31	641	0.0085	0.1751	616	56	99.9	2,066	1,986	181	8	0.002186	26
Compact Fluorescent Lights	6.93	143	0.0019	0.0391	192	4	22.3	462	619	13	8	0.002186	26
Energy Saving Fluorescent Lamps	22.8	471	0.0062	0.1288	497	216	73.5	1,519	1,602	696	144	0.039344	464
Exit Signs	5.38	111	0.0015	0.0304	500	100	17.3	359	1,612	322	4	0.001093	13
F32 T-8 Lighting System	39.7	821	0.0108	0.2242	2317	607	128.0	2,646	7,470	1,957	53	0.014481	171
Economizer Controls	24	496	0.0066	0.1355	2258	1280	77.4	1,599	7,280	4,127	1	0.000273	3
Daylight Dimming Controls	6.2	128	0.0017	0.0350	720	400	20.0	413	2,321	1,290	4	0.001093	13
Water Heater Timers	0.112	2	0.0000	0.0006	40	18	0.4	7	129	58	1	0.000273	3
Water Heater Insulation	1.17	24	0.0003	0.0066	25	18	3.8	78	81	58	1	0.000273	3

ECO	ECO Savings		Average Study Blg Savings		Average Study Blg Cost		Average Group Savings		Average Group Cost		No. of Units Per Study Bldg	Units per Study Blg Floor Area	Total Units Per Group
Subgroup B-1- Study Blg 174	MBtu/Yr	$/Yr	MBtu/ft**2	$/Yr/ft**2	Materials $/ft**2	Labor $/ft**2	MBtu/Yr	$/Yr	Materials $	Labor $			
Low Flow Shower Heads	37.2	769	0.0078	0.1602	150	42	417.1	8,622	1,682	471	6	0.00125	67
Compact Fluorescent Lighting	41.9	868	0.0087	0.1804	322	7	469.8	9,711	3,610	78	14	0.002917	157
Occupancy Sensors	55.4	1,145	0.0115	0.2386	1078	98	621.2	12,840	12,087	1,099	14	0.002917	157
Water Heater Timer	1.13	23	0.0002	0.0049	40	18	12.7	262	449	202	1	0.000208	11
Energy Savings Fluorescent Lamps	19.6	405	0.0041	0.0844	490	213	219.8	4,543	5,494	2,388	142	0.029583	1,592
F32 T-8 Lighting System	12	248	0.0025	0.0517	2904	728	134.6	2,781	32,561	8,140	33	0.006875	370
Water Heater Insulation	1.17	24	0.0002	0.0050	25	18	13.1	271	280	202	1	0.000208	18

ECO	ECO Savings		Average Study Blg Savings		Average Study Blg Cost		Average Group Savings		Average Group Cost		No. of Units Per Study Bldg	Units per Study Blg Floor Area	Total Units Per Group
Subgroup D-1- Study Blg 172	MBtu/Yr	$/Yr	MBtu/ft**2	$/Yr/ft**2	Materials $	Labor $	MBtu/Yr	$/Yr	Materials $	Labor $			
Compact Fluorescent Lights	4.12	85	0.0010	0.0199	142	3	4.1	85	142.00	3.00	6	0.001404	6
Energy Savings Fluorescent Lamps	3.68	76	0.0009	0.0178	131	57	3.7	76	131.00	57.00	38	0.008895	38
Occupancy Sensors	15.46	320	0.0036	0.0748	1213	284	15.5	320	1,213.00	284.00	15	0.003511	15
Exit Sign Retrofit	14.08	291	0.0033	0.0681	1375	275	14.1	291	1,375.00	275.00	11	0.002575	11
Water Heater Timers	0.5	10	0.0001	0.0024	40	18	0.5	10	40.00	18.00	1	0.000234	1
DayLight Dimming Controls	0.56	12	0.0001	0.0027	160	100	0.6	12	160.00	100.00	1	0.000234	1

ECO	ECO Savings		Average Study Blg Savings		Average Study Blg Cost		Average Group Savings		Average Group Cost		No. of Units Per Study Bldg	Units per Study Blg Floor Area	Total Units Per Group
Subgroup E-2 Latrines	MBtu/Yr	$/Yr	MBtu/ft**2	$/Yr/ft**2	Materials $	Labor $	MBtu/Yr	$/Yr	Materials $	Labor $			
Compact Flourescent Lights	6.38	132	0.0446	0.9222	23	2	175.4	3,625	632.28	54.98	4	0.027972	119
Occupancy Sensors	2.12	44	0.0148	0.3064	154	14	58.3	1,205	4,233.38	384.85	2	0.013988	60

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New Buildings List- Buildings built after 1985 Fort A.P. Hill

SUBGROUP A-1

Bldg. No	Description		Floor Area (Ft**2)
1247	Entomology Facility		1,800
1252	General Inst. Bldg		5,000
1253	Range Control Bldg		5,000
		TOTAL	11,800

Automatic Controls For Heat Pumps

LIFE CYCLE COST ANALYSIS SUMMARY
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)

LOCATION: Fort A.P. Hill, Virginia REGION: 3 PROJECT NO.: DACA 31-89-C-0198
PROJECT TITLE: Fort A.P. Hill- Energy Engineering Analysis Program FISCAL YEAR: 1994
DISCRETE PORTION NAME: Automatic Controls For Heatpumps
ANALYSIS DATE: January 1994 ECONOMIC LIFE (YRS 10 PREPARER: JJS

1. INVESTMENT COSTS:

A. CONSTRUCTION COST	$	47,820	
B. SIOH	$	2,630	
C. DESIGN COST	$	2,869	
D. TOTAL COST (1A+1B+1C)	$	53,319	
E. SALVAGE VALUE OF EXISTING EQUIPMENT			
F. PUBLIC UTILITY COMPANY REBATE			
G. TOTAL INVESTMENT (1D-1E-1F)			$53,319

2. ENERGY SAVINGS (+)/COST(-):

DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS- Oct 1992

ENERGY SOURCE	COST $/MBTU(1)	SAVING(S) MBTU/YR(2)	ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELEC	$20.67	2,677.0	$ 55,334	8.39	$ 464,249
B. DIST	$5.69		$		$
C. RESID			$		$
D. NG			$		$
E. LPG	$7.76		$		$
F. COAL			$		$
G. SOLAR			$		$
H. GEOTH			$		$
I. BIOMA			$		$
J. REFUS			$		$
K. WIND			$		$
L. OTHER			$		$
M. DEMAND SAVINGS			$		$
N. TOTAL		2,677	$ 55,334		$ 464,249

3. NON ENERGY SAVINGS (+) OR COST (-):

A. ANNUAL RECURRING (+/-)	($2,100)		
(1) DISCOUNT FACTOR (TABLE A)		8.11	
(2) DISCOUNTED SAVINGS/COST (3A X 3A1)			($17,031)

B. NON RECURRING SAVINGS (+) OR COST (-)

ITEM	SAVINGS(+) COST(-)(1)	YEAR OF OCCUR. (2)	DISCOUNT FACTOR(3)	DISCOUNTED SAVINGS(+)COST(-)(4)
a.	$			$
b.	$			$
c.	$			$
d. TOTAL				$

C. TOTAL NON ENERGY DISCOUNTED SAVINGS (3A2+3Bd4) ($17,031)

4. SIMPLE PAYBACK 1G/(2N3+3A+(3Bd1/ECONOMIC LIFE)): 1.00 YEARS
5. TOTAL NET DISCOUNTED SAVINGS (2N5+3C): $447,218
6. SAVINGS TO INVESTMENT RATION (SIR) 5/1G: 8.39
7. ADJUSTED INTERNAL RATE OF RETURN (AIRR): 24.65%

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CONSTRUCTION COST ESTIMATE

PREPARED: March 1994 SHEET 1 OF 2

PROJECT: Energy Savings Oppurtunity Survey

CONTRACT NO.: DACA 31-89-C-0198

LOCATION: Fort A.P. Hill, Virginia
AE PROJECT NO.: 92008
AE: Engineering Applications Consultants, P.C.

ESTIMATOR: JS
CHECKED BY: VP
PRELIM:
FINAL: X

SUMMARY: Automatic Controls For Heat Pumps

ITEM	QUANTITY NO.	QUANTITY MEAS	MATERIAL UNIT	MATERIAL COST	LABOR UNIT	LABOR COST	TOTAL COST
Night Setback							
SUBGROUP							
Administration Buildings	30	EA	320.00	9,600	75.00	2,250	11,850
Dinning Facilities	7	EA	320.00	2,240	75.00	525	2,765
Housing Facilities	50	EA	320.00	16,000	75.00	3,750	19,750
SUB-TOTAL				27,840		6,525	34,365

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CONSTRUCTION COST ESTIMATE	PREPARED: March 1994 SHEET OF
PROJECT: Energy Savings Oppurtunity Survey	SHEET 2 OF 2 CONTRACT NO.: DACA 31-89-C-0198
LOCATION: Fort A.P. Hill, Virginia AE PROJECT NO.: AE: Engineering Applications Consultants, P.C.	ESTIMATOR: JS PRELIM: CHECKED BY: VP FINAL: X

SUMMARY: Automatic Controls For Heat Pumps

ITEM	QUANTITY		MATERIAL		LABOR		TOTAL COST
	NO.	MEAS	UNIT	COST	UNIT	COST	
SUBTOTAL PREV. PAGE				27,840		6,525 *p1938X	34,365
MARK-UP ON LABOR SUB-TOTAL	21.0%			—		1,370	1,370 35,735
TAXES ON MATERIAL SUB-TOTAL	5.0%			1,392		—	1,392 37,127
OVERHEAD SUB-TOTAL	15.0%						5,569 42,696
PROFIT SUB-TOTAL	12.0%						5,124 47,820
PRIME MARK-UP ON SUB SUB-TOTAL							47,820
GRAND TOTAL							47,800

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Energy Conservation Oppurtunity Summary: Automatic Controls for Heat Pumps

Study Building	Floor Area (Ft^2)	Existing Energy Usage		Total Energy Savings	
		MBtu/Yr	$/Yr	MBtu/Yr	$/Yr
172	4,800	438.1	8,088	109.1	2,255
174	4,272	378.7	6,992	74.3	1,536
1253	5,000	280.1	5,183	28.2	583

Sub Group	Study Bldg.	Applied Subgroup (Ft^2)	Average Study Building Savings		Total Applied Group Savings	
			Energy (MBtu/Ft^2-Yr)	$/$Ft^2$-Yr	Energy (MBtu/Yr)	$/Yr
Admin	1253	63,939	.0077	0.14	492.3	10,175
Housing	174	108,530	.0174	0.32	1,888.4	39,033
Dinning	172	13,040	.0227	0.42	296.0	6,118
TOTAL					2,676.7	55,327

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TABLE 1.0- HEAT PUMP BUILDINGS LIST FORT A.P. Hill [1]

ADMIN	FT²	HOUSING	FT²	DINING	FT²
106	5,320	174	4,800	172	4,272
124	2,490	253	1,152	TO216	3,500
742	3,066	290	1,056	TO303	5,268
1220	6,464	292	1,056		
1252	5,000	293	1,175		
1253	5,000	294	1,175		
1650	3,363	1350	7,256		
SO137	1,740	1351	7,256		
TO101	5,080	1352	7,256		
TO102	1,604	1353	3,804		
TO105	2,273	1354	2,553		
TO114	1,440	1355	4,816		
TO120	2,100	1356	7,737		
TO122	1,455	1357	7,256		
TO126	2,634	SO201	3,106		
TO127	2,526	SO251	5,120		
TO128	2,668	SO254	1,526		
TO143	3,788	SO308	3,247		
TO163	1,920	SO313	1,300		
TO217	2,088	SO801	2,740		
TO714	1,920	TO117	2,400		
		TO118	2,400		
		TO119	2,400		
		TO125	2,541		
		TO130	861		
		TO131	861		
		TO132	800		
		TO133	800		
		TO142	3,384		
		TO146	2,200		
		TO207	444		
		TO208	5,220		
		TO209	532		
		TO211	995		
		TO215	3,061		
		TO252	576		
		TO712	960		
		TO713	960		
		TO715	960		
		T1205	788		
TOTAL	63,939		108,530		13,040

[1]SOURCE: Buildings list printout Fort A. P. Hill (New and Renovated Buildings)

ENERGY BUDGET <A>

Building : #172-Night Setback 02-28-94
Site : Fort AP Hill, Virginia 6063092204
Prepared By : E.A.C., P.C. Burke, VA
Carrier Hourly Analysis Program

TABLE 1. ANNUAL LOADS

Component	(kBTU)	(kBTU/sqft)*
Cooling Loads *	76,907	15.391
Heating Loads *	99,012	19.814

TABLE 2. ENERGY BY SYSTEM COMPONENT

Component	<----- Site Energy ----->		<---- Source Energy ---->	
	(kBTU)	(kBTU/sqft)*	(kBTU)	(kBTU/sqft)*
Air System Fans	31,511	6.306	31,511	6.306
Cooling Plants	31,370	6.278	31,370	6.278
Heating Plants	96,584	19.328	96,584	19.328
Pumps	0	0.000	0	0.000
>> HVAC Total	159,465	31.912	159,465	31.912
Lights	64,051	12.818	64,051	12.818
Other Electric	49,567	9.919	49,567	9.919
Misc. Electric	0	0.000	0	0.000
Dom. Hot Water	55,879	11.182	55,879	11.182
>> Non-HVAC Total	169,497	33.920	169,497	33.920
>> GRAND TOTAL	328,962	65.832	328,962	65.832

* Notes:
1. Site energy is the actual energy consumed.
2. Source energy accounts for electrical generating inefficiencies. For this study:
   Electric generating efficiency =100.0 %
3. Energy per unit floor area is based on the gross building floor area. For this building:
   Gross floor area = 4,997 sqft
   Conditioned floor area = 4,997 sqft
4. Annual cooling load is the sum of all cooling plant loads.
5. Annual heating load is the sum of all primary and auxiliary heating plant loads. It does not include the domestic water heating load.

ENERGY BUDGET <A>

Building : 174-Night Setback
Site : Fort AP Hill, Virginia
Prepared By : E.A.C., P.C. Burke, VA
Carrier Hourly Analysis Program

02-17-94
6063092204

TABLE 1. ANNUAL LOADS

Component	(kBTU)	(kBTU/sqft)*
Cooling Loads *	70,035	14.591
Heating Loads *	74,485	15.518

TABLE 2. ENERGY BY SYSTEM COMPONENT

	<----- Site Energy ----->		<---- Source Energy ---->	
Component	(kBTU)	(kBTU/sqft)*	(kBTU)	(kBTU/sqft)*
Air System Fans	13,990	2.915	14,276	2.974
Cooling Plants	27,551	5.740	28,113	5.857
Heating Plants	69,236	14.424	70,649	14.719
Pumps	0	0.000	0	0.000
>> HVAC Total	110,778	23.079	113,038	23.550
Lights	60,081	12.517	61,307	12.772
Other Electric	41,588	8.664	42,437	8.841
Misc. Electric	0	0.000	0	0.000
Dom. Hot Water	91,962	19.159	93,839	19.550
>> Non-HVAC Total	193,631	40.340	197,583	41.163
>> GRAND TOTAL	304,409	63.419	310,622	64.713

* Notes:
1. Site energy is the actual energy consumed.
2. Source energy accounts for electrical generating inefficiencies. For this study:
   Electric generating efficiency = 98.0 %
3. Energy per unit floor area is based on the gross building floor area. For this building:
   Gross floor area = 4,800 sqft
   Conditioned floor area = 4,549 sqft
4. Annual cooling load is the sum of all cooling plant loads.
5. Annual heating load is the sum of all primary and auxiliary heating plant loads. It does not include the domestic water heating load.

ENERGY BUDGET <A>

Building : 1253RangCon-Nite Setback 02-16-94
Site : FORT A.P. HILL, Virginia 6063092204
Prepared By : E.A.C., P.C. Burke, VA
Carrier Hourly Analysis Program

TABLE 1. ANNUAL LOADS

Component	(kBTU)	(kBTU/sqft)*
Cooling Loads *	146,803	29.361
Heating Loads *	3,912	0.782

TABLE 2. ENERGY BY SYSTEM COMPONENT

Component	<----- Site Energy -----> (kBTU)	(kBTU/sqft)*	<---- Source Energy ----> (kBTU)	(kBTU/sqft)*
Air System Fans	17,167	3.433	18,071	3.614
Cooling Plants	63,260	12.652	66,590	13.318
Heating Plants	3,770	0.754	3,968	0.794
Pumps	0	0.000	0	0.000
>> HVAC Total	84,197	16.839	88,629	17.726
Lights	113,618	22.724	119,597	23.919
Other Electric	42,081	8.416	44,295	8.859
Misc. Electric	0	0.000	0	0.000
Dom. Hot Water	11,985	2.397	12,616	2.523
>> Non-HVAC Total	167,684	33.537	176,509	35.302
>> GRAND TOTAL	251,881	50.376	265,138	53.028

* Notes:
1. Site energy is the actual energy consumed.
2. Source energy accounts for electrical generating inefficiencies. For this study:
   Electric generating efficiency = 95.0 %
3. Energy per unit floor area is based on the gross building floor area. For this building:
   Gross floor area = 5,000 sqft
   Conditioned floor area = 3,660 sqft
4. Annual cooling load is the sum of all cooling plant loads.
5. Annual heating load is the sum of all primary and auxiliary heating plant loads. It does not include the domestic water heating load.

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APPENDIX E- PROGRAMMING DOCUMENTATION

Appendix E Table of Contents

Energy Savings Opportunity Survey
FORT A.P. HILL, VIRGINIA

ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)

1.0 INTRODUCTION

An Energy Savings Opportunity Survey (ESOS) was done in 1994 to improve energy efficiency by analyzing existing building systems and recommended energy conservation opportunities to improve their energy efficiency and lower energy costs.

2.0 DESCRIPTION OF ECOS

The collected data was subjected to a detailed analysis based on Army criteria for qualifying for ECIP projects.

Install Low Flow Shower Heads (2 to 3 GPM)

Replace high flow (5 to 7 GPM) shower heads with low flow heads to conserve hot water energy usage in buildings with showers. The following buildings are included for this ECO:

174	290	1247	1252	1253	1350	1351	1352	1353	1354	1355	1356	1357

Replace Incandescent Lamps With Compact Fluorescent Lamps

Incandescent lamps are costly to operate and have a short lifetime when compared to compact fluorescent lights. Areas where lighting is used only for general illumination such as bathrooms, hall ways, etc., incandescent lamps can be replaced with a lower wattage, longer life compact fluorescent lamp. The following buildings are included for this ECO:

172	174	290	412	413	529	531	733	745	746	748	826	828
839	924	928	1008	1024	1108	1109	1110	1114	1116	1202	1241	1247
1252	1253	1254	1256	1263	1350	1351	1352	1353	1354	1355	1356	1357
1403	1405	1428	1619	1670S	1272							

Night Setback

This ECO includes the automatic reduction of the thermostat heating set-point and cooling system shut-off during unoccupied hours. The list of buildings for this ECO utilize fossil fuel fired furnaces as a source of heat. The following buildings were included for this project:

179	102	1214	117	132	208	309	1528	216	1262	106A	1224	118
133	209	310	1529	113	135	224	1525	192	1226	119	146	227
311	1532	116	137	303	1527	151	1290	125	179	253	305	506
1533	121	144	304	1535	313	1291	130	205	254	306	707	1622
123	145	820	2001	708	131	207	308	801				

Automatic Controls for Heat Pumps

Install new thermostats to avoid the use of the electrical resistance heat element as a source of heat in new buildings with heat pump systems. The following buildings are included for this ECO:

106	124	172	174	253	290	292	293	294	742	1220	1252	1253
1350	1351	1352	1353	1354	1355	1356	1357	1650				
SO137	SO201	SO251	SO254	SO308	SO313	SO801	TO101	TO102	TO105	TO114	TO117	TO118
TO119	TO120	TO122	TO125	TO126	TO127	TO128	TO130	TO131	TO132	TO133	TO143	TO142
TO146	TO163	TO207	TO208	TO209	TO211	TO215	TO216	TO217	TO252	TO303	TO712	TO713
TO714	TO715	T1205										

Photocell Controls in Building 179

This ECO proposes the installation of photocell controls on exterior lighting in building 179. The exterior lighting is manually controlled and found to be left on during the daylight hours. Automatic controls are available to turn the exterior lights on and off according to the amount of daylight available.

Replacing Fluorescent Lamps with High Efficiency Types

This ECO proposes the replacement of 3053 fluorescent lamps with their corresponding high efficiency type, for example, replacing the F96T12 (110 watts) cool white high output lamp with 95 watt F96T12 cool white high output. This ECO involves the following buildings:

101	102	103	104	106A	106B	108	109	113	115	116	120	121
122	123	124	125	126	127	128	129	130	131	132	133	134
135	136	137	139	140	142	143	144	145	148	149	151	158
163	175	178	179A	179B	182	201	206	209	211	214	217	192
220	222	224	226	227	250	251	253	257	258	292	293	294
303	304	305	306	309	310	311	312	313	320	322	323	324
325	326	327	328	329	330	331	332	333	334	335	336	337
338	339	340	341	342	343	344	345	346	347	348	349	350
351	352	353	354	355	356	357	358	359	360	361	362	363
364	388	501	506	512	515	530	705	707	708	711	712	713
714	715	730	801	803	804	807	808	811	812	813	814	815
817	818	820	821	826	985	986	989	1071	1201	1204	1205	1206
1207	1208	1210	1211	1213	1213B	1214	1215	1216	1217	1219	1220	1221
1222	1224	1225	1226	1227	1230	1231	1262	1268B	1282	1290	1293	1296
1301	1304	1320	1321	1323	1324	1326	1327	1401	1404	1423	1424	1425
1474	1501	1504	1521	1522	1523	1524	1525	1526	1527	1528	1529	1532
1533	1535	1538	1545	1546	1601	1604	1623	1624	1630	1632	1633	1634
1641	1650	1654	1656	1659	1664	1672	1673	1677	1679	1683	1684	1685
1687	1690	2001	2002									

Install Occupancy Sensors to Control Lighting

Occupancy sensors can be installed in areas where there may be unnecessary lighting of unused space. The occupancy sensor would detect when an area is unoccupied and, after a

pre-determined length of time, would automatically switch the lights off. The following buildings are included for this ECO:

172	174	290	412	413	529	531	733	745	746	748	826	828
839	924	928	1008	1024	1108	1109	1110	1114	1116	1202	1241	1247
1252	1253	1254	1256	1263	1350	1351	1352	1353	1354	1355	1356	1357
1403	1405	1428	1619	1670	S1272							

Energy Saving Fluorescent Lamps

The savings in electrical energy are obtained by removing the existing standard 40 watt fluorescent lamps and replacing them with 34 watt energy saving fluorescent lamps. The following buildings are included for this ECO:

172 174 290 1247 1252 1253 1350 1351 1352 1353 1354 1355 1356
1357

Shut Down Energy to Hot Water Heaters or Modify Controls

Water heaters operate 24 hours a day to maintain the storage tank temperature. Installing time clocks to turn off the buildings hot water heater during unoccupied periods or at night can reduce the energy used during this period. The following buildings are included for this ECO:

172 174 290 1247 1252 1253 1350 1351 1352 1353 1354 1355 1356
1357

Hot Water Circulating Pump Controls

Domestic hot water circulating pumps operate 24 hours a day in building 179. This ECO proposes the installation of a time clock to automatically shut down the domestic water circulating pump during unoccupied periods.

Replacement of Inefficient Light Fixtures

The purpose of this option is to replace incandescent lighting with fluorescent lighting and provide the same light levels at a lower energy consumption level. This ECO proposes the replacement of 228 incandescent and 237 F40T12 Fluorescent Lighting fixtures to 525 F32T-8 Fluorescent Lighting in the following buildings:

253 305 306 820 821 1290 1525 1526 1528 1529 1532 1533

Insulation of Domestic Water Heaters

This ECO proposes the up-grading of insulation levels on domestic water heaters and storage tanks. Small electric water heaters would receive an additional 1-1/2" (R4) thick fiberglass

wrap kit. Large, oil-fired tanks would receive an additional 3" (R11) thick fiberglass layer and a vinyl jacket. The following buildings are included in this analysis:

1526	1528	1529	1532	1533	1635	1636	1637	1638	1639	1640	1642
1643	1644	1645	1646	1647	1648	1649	1651	1652	1653	1657	1658
1662	1663	1666	1667	1668	1669	1671	1680	1681	1682	1688	1689
1691	1692	1693	1695	1696	1694	820	1525	1641	1659	1690	305
306	506	530	1320	1521	1522	1622	172	174	290	1247	1252
1253	1350	1351	1352	1353	1354	1355	1356	1357			

Replace Incandescent Exit Sign Fixtures with LED (Light Emitting Diode) Fixtures

Exit signs operate 24 hours per day, 365 days a year. Field surveys have shown that the existing exit signs utilize two 25 watt incandescent lamps for lighting. LED exit signs operate at lower wattages and the lamps last up to 30 years. The following buildings are included in this ECO:

172	174	290	1247	1252	1253	1350	1351	1352	1353	1354	1355	1356
1357												

Replace Existing Fluorescent Fixtures with New Energy Efficient Fixtures, Ballasts and Energy Conserving Lamps

Standard four tube F40 T12 fluorescent lighting fixture (standard ballast) consumes about 190 watts per fixture. These lighting fixtures can be replaced with F32 T8 fluorescent light fixtures with electronic ballasts. The T8 lamps only consume 32 watts as compared to 40 watts for the standard fluorescent lamp and the T8 light fixture (4 lamps, 2 ballasts) consumes about 140 watts per fixture. The following buildings are included in this ECO:

172	174	290	1247	1252	1253	1350	1351	1352	1353	1354	1355	1356
1357												

Ceiling Insulation

This ECO consists of the addition of R-19 (blown cellulose fill) insulation to the ceilings of buildings with attics. The increase in the thermal resistance of the ceiling would reduce the heat loss across the surface during the winter and reduce the heat gain during the summer. The following 126 buildings were included in this ECO:

102	103	104	105	109	113	115	116	120	121	122	123	129
135	136	139	140	144	145	148	149	151	158	214	219	220
224	227	250	258	304	305	306	309	310	311	312	313	320
321	322	323	324	325	326	327	328	329	330	331	332	333
334	335	336	337	338	339	340	341	342	343	344	345	346
347	348	349	350	351	352	353	354	356	357	358	359	360
361	362	363	364	501	506	705	707	708	801	803	808	811
812	813	814	815	816	817	818	820	821	1201	1206	1213	1214
1221	1222	1225	1227	1231	1262	1282	1291	1301	1401	1501	1535	1526
1527	1528	1529	1532	1533	1601	1622	2001	9071				

3.0 POTENTIAL SAVINGS

The alternative recommended above has a potential savings in energy consumption of 16,099 MBTU per year at a cost savings of $210,818 per year for energy, with an additional savings of $17,183 for non-energy related items.

The total cost of this project is $445,566 (FY 1994) excluding design and supervision, inspection, and overhead (SIOH) costs.

In the analysis of the Life Cycle Cost for the entire project, the Summary sheet herein does not specify an absolute economic life because this varies among the different sub-projects. Thus following, uniform discount factors could not be assigned, but rather total discounted savings for energy, non-energy, and non-recurring items have been totaled and brought forward from the individual discrete sub-projects.

3.1 Metering

Presently, the metering of the energy consumption consists of recording of utility billing. Billing for the electricity is broken down into four substations and fuel oils and LP gas are delivered monthly for the entire post. The energy conservation measures recommended are based on field surveys, interviews with the operating personnel, and recommendations from the Army Corps of Engineers.

3.1.1 Calculations for energy savings were subjected to rigorous analysis, as per (ECIP) guidelines. However, the energy savings accrued will depend on the implementation as recommended, and following the recommended operational, maintenance, and repair procedures.

1. COMPONENT	FY 1995 MILITARY CONSTRUCTION PROJECTS DATA	2. DATE
ARMY		APRIL 1994

3. INSTALLATION AND LOCATION	4. PROJECT TITLE
FORT A.P. HILL, VIRGINIA	ECIP: ESOS FORT A.P. HILL

5. PROGRAM ELEMENT	6. CATEGORY CODE	7. PROJECT NUMBER	8. PROJECT COST

9. COST ESTIMATES

ITEM	U/M	QUANTITY	UNIT COST	COST ($000)
Low Flow Shower Heads: Buildings Included- 174, 290,1247, 1252, 1253, 1350, 1351, 1352, 1353, 1354, 1355, 1356, 1357				3.130
Replace Incandescent Lamps with Compact Fluorescent Lamps: Buildings Included: 172 174 290 412 413 529 531 733 745 746 748 826 828 839 924 928 1008 1024 1108 1109 1110 1114 1116 1202 1241 1247 1252 1253 1254 1256 1263 1350 1351 1352 1353 1354 1355 1356 1357 1403 1405 1428 1619 1670 S1272				9.827
Night Set Back: Buildings Included: 179 102 1214 117 132 208 309 1528 216 1262 106A 1224 118 133 209 310 1529 113 135 224 1525 192 1226 119 146 227 311 1532 116 137 303 1527 151 1290 125 179 253 305 506 1533 121 144 304 1535 313 1291 130 205 254 306 707 1622 123 145 820 2001 708 131 207 308 801				37.631
Automatic Controls for Heat Pumps: Buildings Included: 106 124 172 174 253 290 292 293 294 742 1220 1252 1253 1350 1351 1352 1353 1354 1355 1356 1357 1650 S0137 S0201 S0251 S0254 S0308 S0313 S0801 T0101 T0102 T0105 0114 T0117 T0118 T0119 T0120 T0122 T0125 T0126 T0127 T0128 .0130 T0131 T0132 T0133 T0143 T0142 T0146 T0163 T0207 T0208 T0209 T0211 T0215 T0216 T0217 T0252 T0303 T0712 T0713 T0714 T0715 T1205				47.820
Photocell Controls Building 179				0.679
Replacing Fluorescent Lamps with High Efficiency Types: Buildings Included: 101 102 103 104 106A 106B 108 109 113 115 116 120 121 122 123 124 125 126 127 128 129 130 131 132 133 134 135 136 137 139 140 142 143 144 145 148 149 151 158 163 175 178 179A 179B 182 201 206 209 211 214 217 219 220 222 224 226 227 250 251 253 257 258 292 293 294 303 304 305 306 309 310 311 312 313 320 322 323 324 325 326 327 328 329 330 331 332 333 334 335 336 337 338 339 340 341 342 343 344 345 346 347 348 349 350 351 352 353 354 355 356 357 358 359 360 361 362 363 364 388 501 506 512 515 530 705 707 708 711 712 713 714 715 730 801 803 804 807 808 811 812 813 814 815 817 818 820 821 826 985 986 989 1071 1201 1204 1205 1206 1207 1208 1210 1211 1213 1213B 1214 1215 1216 1217 1219 1220 1221 1222 1224 1225 1226 1227 1230 1231 1262 1268B 1282 1290 1293 1296 1301 1304 1320 1321 1323 1324 1326 1327 1401 1404 1423 1424 1425 1474 1501 1504 1521 1522 1523 1524 1525 1526 1527 1528 1529 1532 1533 1535 1538 1545 1546 1601 1604 1623 1624 1630 1632 1633 1634 1641 1650 1654 1656 1659 1664 1672 1673 1677 1679 1683 1684 1685 1687 1690 2001 2002				17.500
Occupancy Sensors: Buildings Included: 172 174 290 412413 529 531 733 745 746 748 826 828 839 924 928 1008 1024 1108 1109 1110 1114 1116 1202 1241 1247 1252 1253 1254 1256 1263 1350 1351 1352 1353 1354 1355 1356 1357 1403 1405 1428 1619 1670 S1272				29.681
Energy Saving Fluorescent Lamps: Buildings Included: 172 174 290 1247 1252 1253 1350 1351 1352 1353 1354 1355 1356 1357				14.665
Shut Down Energy to Hot Water Heaters or Modify Controls: Buildings Included 172 174 290 1247 1252 1253 1350 1351 1352 1353 1354 355 1356 1357				0.908

FOR OFFICIAL USE ONLY
(WHEN DATA IS ENTERED)

1. COMPONENT ARMY	FY 1995 MILITARY CONSTRUCTION PROJECTS DATA	2. DATE APRIL 1994

3. INSTALLATION AND LOCATION	4. PROJECT TITLE
FORT A.P. HILL, VIRGINIA	ECIP: ESOS FORT A.P. HILL

5. PROGRAM ELEMENT	6. CATEGORY CODE	7. PROJECT NUMBER	8. PROJECT COST

9. COST ESTIMATES

ITEM	U/M	QUANTITY	UNIT COST	COST ($000)
Hot Water Circulating Pump Controls Blg 179				0.238
Replacement of Inefficient Light Fixtures: Buildings Involved: 253* 305 306 820 821 1290 1525 1526* 1528* 1529*1532* 1533				111.658
Insulation of Domestic Water Heaters: Buildings Included- 1526 1528 1529 1532 1533 1635 1636 1637 1638 1639 1640 1642 1643 1644 1645 1646 1647 1648 1649 1651 1652 1653 1657 1658 1662 1663 1666 1667 1668 1669 1671 1680 1681 1682 1688 1689 1691 1692 1693 1695 1696 1694 820 1525 1641 1659 1690 305 306 506 530 1320 1521 1522 1622 172 174 290 1247 1252 1253 1350 1351 1352 1353 1354 1355 1356 1357				26.765
Exit Sign Replacement: Buildings Included- 172 174 290 1247 1252 1253 1350 1351 1352 1353 1354 1355 1356 1357				4.992
Replace Existing Fluorescent Fixtures with Energy Efficient Fixtures: Buildings Included- 172 174 290 1247 1252 1253 1350 1351 1352 1353 1354 1355 1356 1357				14.912
Ceiling Insulation: Buildings Included- 102 103 104 105 109 113 115 116 120 121 122 123 129 135 136 139 140 144 145 148 149 151 158 214 219 220 224 227 250 258 304 305 306 309 310 311 312 313 320 321 322 323 324 325 326 327 328 329 330 331 332 333 334 335 336 337 338 339 340 341 342 343 344 345 346 347 348 349 350 351 352 353 354 356 357 358 359 360 361 362 363 364 501 506 705 707 708 801 803 808 811 812 813 814 815 816 817 818 820 821 1201 1206 1213 1214 1221 1222 1225 1227 1231 1262 1282 1291 1301 1401 1501 1535 1526 1527 1528 1529 1532 1533 1601 1622 2001 9071				125.160
Subtotal				445.566
Escalation to April 1995 (3.5%)				15.600
Subtotal				461.166
Contingency (5.0%)				23.058
Total Contract Cost				484.224
Supervision, Inspection & Overhead (6.0%)				29.053
Design Cost (5.5%)				26.632
Total Rounded Request				540.000

10. **Description of Proposed Construction:**
The proposed project consists of installing the following energy conserving opportunities (ECO's) to reduce energy usage:

Low Flow Shower Heads: Replace shower heads that currently use 5-7 gallons per minute with heads that use 2 to 3 gallons per minute. Savings are achieved by reducing hot water heating costs.

**FOR OFFICIAL USE ONLY
(WHEN DATA IS ENTERED)**

1. COMPONENT ARMY	FY 1995 MILITARY CONSTRUCTION PROJECTS DATA	2. DATE APRIL 1994

3. INSTALLATION AND LOCATION

FORT A.P. HILL, VIRGINIA

4. PROJECT TITLE ECIP IMPROVEMENTS: ESOS FORT A.P. HILL	5. PROJECT NUMBER

Replace Incandescent Lamps with Compact Fluorescent Lamps: The existing incandescent light bulbs (75 watts) will be replaced with screw in type compact fluorescent bulbs (18 watts).

Night Setback: Install automatic thermostats on gas/oil fired heating boilers to set back building temperatures during unoccupied periods. Reducing the thermostat settings 10-15 degrees will save energy.

Automatic Controls for Heat Pumps: Install heat pump thermostats that will automatically set back the temperature during unoccupied periods and during morning warm up avoid the use of the electric emergency resistance heating.

Replacing Fluorescent Lamps with High Efficiency Types: Replace standard fluorescent lamps with energy efficient lamps. Energy efficient lamps provide the same amount of light at a reduced wattage.

Occupancy Sensors: Occupancy Sensors will be installed in areas were lighting is left on during unoccupied periods.

nergy Saving Fluorescent Lamps: Replace 40 watt F40 four foot fluorescent lamps with 34 watt energy saving lamps. An energy savings of 6 watts per lamp can be achieved.

Shut Down Energy to Hot Water Heaters or Modify Controls: Install time clocks to automatically turn hot water heaters on and off during long unoccupied periods.

Replacement of Inefficient Light Fixtures: Replace incandescent light fixtures with energy efficient F32T-8 fluorescent lighting fixtures.

Insulation of Domestic Water Heaters: Add additional insulation to hot water heaters and storage tanks. This will effectively reduce the stand by tank energy losses.

Exit Sign Replacement: Replace the existing incandescent exit signs with Light Emitting Diode (LED) exit fixtures. A savings of about 44 watts per fixture can be achieved with this ECO.

Replace Existing Fluorescent Fixture with New Energy Efficient Fixtures: Replace existing four tube, 40 watt fluorescent fixtures with 32 watt T-8 fluorescent lighting systems.

Ceiling Insulation: Add additional ceiling insulation to buildings with less than 3 inches of insulation. The roof system heat transmission will be reduced by installing R-30 insulation.

FOR OFFICIAL USE ONLY
(WHEN DATA IS ENTERED)

1.COMPONENT ARMY	FY 1995 MILITARY CONSTRUCTION PROJECTS DATA	2. DATE APRIL 1994

3. INSTALLATION AND LOCATION

FORT A.P. HILL, VIRIGINIA

4. PROJECT TITLE	5. PROJECT NUMBER
ECIP IMPROVEMENTS: ESOS FORT A.P. HILL	

Photocells in Building 179

This ECO proposes the installation of photocell controls on exterior lighting in building 179. The exterior lighting is manually controlled and found to be left on during the daylight hours. Automatic controls are available to turn the exterior lights on and off according to the amount of daylight available.

Hot Water Circulating Pump Controls

Domestic hot water circulating pumps operate 24 hours a day in building 179. This ECO proposes the installation of a time clock to automaticly shut down the domestic water circulating pump during unoccupied periods.

11. **Project:**

This project will provide energy saving lighting, HVAC, and hot water systems recommendations at Fort A.P. Hill, Virginia.

Requirement: Fort A.P. Hill will reduce energy consumption and operating and maintenance costs to help comply with Executive Order 12902 "Energy Efficiency and Water Conservation at Federal Facilities." The total project savings-to-investment ratio (SIR) for this work is 5.05.

Impact if Not Provided: If this project is not executed, Fort A.P. Hill will not achieve annual savings of $210,818 in energy costs, $17,183 in non-energy related costs, and a potential reduction in energy consumption of 16,099 Mbtu. The base will also fail to contribute to energy conservation goals established for US Army facilities by the Army headquarters.

Cost Development Study Date:	April 1994	Index:	1925
Estimated Construction Start:	April 1995	Index:	1992
Estimated Midpoint Construction:	October 1995	Index:	2029
Estimated Construction Completion:	April 1996	Index:	2055

Detailed Justifications

D-1 General: The project is dictated by the Army's goal to reduce energy consumption by making efficient use of energy resources at the facilities. This will increase the base's capability to achieve budgetary reductions.

1. COMPONENT ARMY	FY 1995 MILITARY CONSTRUCTION PROJECTS DATA	2. DATE APRIL 1994

. INSTALLATION AND LOCATION

FORT A.P. HILL, VIRGINIA

4. PROJECT TITLE	5. PROJECT NUMBER
ECIP IMPROVEMENTS: ESOS FORT A.P. HILL	

D-2 Accommodations Now in Use: The existing buildings and building systems are operating inefficiently. Lighting systems are old lighting technology, heating/cooling system controls are manual controlled and buildings are lacking in insulation.

D-3 Analysis of Deficiency: Many of the buildings listed in this project are lighted by incandescent lighting, inefficient lamps and lighting controls. In addition, night setback controls and lack of insulation in buildings and around water heaters contribute towards an estimated energy waste of 16,099 Mbtu per year.

D-4 Consideration of Alternatives: Various options have been evaluated thoroughly under an Energy Savings Opportunity Survey (ESOS). The recommended options for this project are feasible and meet predetermined economic criteria.

D-5 Criteria for Proposed Project: The installation will be performed as per applicable codes, rules and regulations.

D-6 Program for Related Equipment: All required materials will be furnished and installed as a part of this project.

D-7 Disposal of Present Assets: None of the present assets will require disposal.

D-8 Survival Measures: Not applicable.

D-9 Summary of Environmental Consequences: Environmental impact of this project is only beneficial. Reduced energy usage will conserve resources of fuel oil and those used in generation of electricity, and also result in reduction of emissions from the power plants.

D-10 Evaluation of Flood Hazard and Encroachment of Wetlands: Not applicable.

D-11 Economic Justification: Completion of the proposed project will result in net energy savings of 16,099 Mbtu and $235,824 annually in total operating costs, without including a non-recurring cost of $7,823. The total savings-to-investment ratio (SIR) is 5.05.

D-12 Utility and Telecommunication Support: No additional utility or telecommunication support is required.

D-13 Protection of Historic Places and Archeological Sites: None of the project elements has any impact on the historic character of any facility.

1. COMPONENT ARMY	FY 1995 MILITARY CONSTRUCTION PROJECTS DATA	2. DATE APRIL 1994

3. INSTALLATION AND LOCATION

FORT A.P. HILL, VIRGINIA

4. PROJECT TITLE ECIP IMPROVEMENTS: ESOS FORT A.P. HILL	5. PROJECT NUMBER

D-14 Project Development Brochure: An engineering study was completed in April 1994, and an executive summary is attached.

D-15 Energy Requirements: The subject project will reduce present energy consumption by 16,099 Mbtu annually. See Energy Requirements Appraisal (ERA) in Special Requirements Paragraph 3 (SRP-3).

D-16 Provision for the Handicapped: The proposed project does not impact the architectural character of the buildings involved and, hence, no design for the handicapped is involved.

D-17 Real Property Maintenance Activity (RPMA) Analysis:

A. Physical Impact: There will be a savings of approximately $17,183 per year in maintenance activity if all of the recommended modifications are implemented. There will be no increase or decrease in real property inventory.

B. Backlog of Maintenance and Repair (BMAR) Impact: The Lighting systems life expectancy will not be affected. There will be no impact on BMAR.

D-18 Commercial Activities: The proposed project affects only systems of existing activities and does not involve expansion of any facilities for any new function.

Special Requirements Paragraph 3 (SRP3):
Energy Requirements Appraisal (ERA)

1. Project Description: The following energy conservation measures will be installed in the buildings named in block 9 at Fort A.P. Hill, VA:

   Low Flow Shower Heads
   Replace Incandescent Lamps with Compact Fluorescent Lamps
   Night Set Back
   Automatic Controls for Heat Pumps
   Replacing Fluorescent Lamps with High Efficiency Types
   Occupancy Sensors
   Energy Saving Fluorescent Lamps
   Shut Down Energy to Hot Water Heaters or Modify Controls
   Replacement of Inefficient Light Fixtures
   Insulation of Domestic Water Heaters
   Exit Sign Replacement
   Replace Existing Fluorescent Fixtures w/ Energy Efficient Fixtures
   Ceiling Insulation
   Photocells in Building 179
   Hot Water Circulating Pump Controls

1. COMPONENT ARMY	**FY 1995 MILITARY CONSTRUCTION PROJECTS DATA**	2. DATE APRIL 1994

3. INSTALLATION AND LOCATION

FORT A.P. HILL, VIRGINIA

4. PROJECT TITLE ECIP IMPROVEMENTS	5. PROJECT NUMBER

2. Estimated Energy Consumption: The existing energy consumption on Fort A.P.Hill consumes approximately 78,126 Mbtu annually. The project, when fully implemented, will generate net annual energy savings of 16,099 Mbtu.

3. Energy Sources: No new energy sources will be required.

4. Energy Use Impacts: The proposed project will reduce the burden on existing fuel distribution system.

5. Energy Conservation: The annual energy consumption will be reduced by 16,099 Mbtu annually.

6. Energy Alternatives: The proposed project will reduce the annual energy consumption by about 20% without effecting the base mission.

7. Energy Effects: The proposed improvements have a positive environmental effect. By reducing demand for energy, it effectively reduces consumption of non-renewable fuel sources and resulting polluting emissions from electric generation.

8. Basis of Approval: Total energy requirements and alternative fuel sources have been considered and included in this appraisal or discarded as inapplicable.

Back up Calculations and Cost Estimates

LIFE CYCLE COST ANALYSIS SUMMARY
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)

LOCATION: Fort A.P. Hill, Virginia REGION: 3 PROJECT NO.: DACA 31-89-C-0198
PROJECT TITLE: Fort A.P. Hill- Energy Engineering Analysis Program FISCAL YEAR: 1994
DISCRETE PORTION NAME: Project Analysis Sheet
ANALYSIS DATE: January 1994 ECONOMIC LIFE (YRS Varies PREPARER: JJS

1. INVESTMENT COSTS:

A. CONSTRUCTION COST	$	445,566	
B. SIOH	$	24,506	
C. DESIGN COST	$	26,734	
D. TOTAL COST (1A+1B+1C)	$	495,784	
E. SALVAGE VALUE OF EXISTING EQUIPMENT			
F. PUBLIC UTILITY COMPANY REBATE			
G. TOTAL INVESTMENT (1D-1E-1F)			$495,784

2. ENERGY SAVINGS (+)/COST(-):

DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS- Oct 1992

ENERGY SOURCE	COST $/MBTU(1)	SAVING(S) MBTU/YR(2)	ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELEC	$20.67	7,958	$ 164,500		$ 1,788,128
B. DIST	$5.69	8,140	$ 46,318		$ 699,390
C. RESID			$		$
D. NG			$		$
E. LPG	$7.76		$		$
F. COAL			$		$
G. SOLAR			$		$
H. GEOTH			$		$
I. BIOMA			$		$
J. REFUS			$		$
K. WIND			$		$
L. OTHER			$		$
M. DEMAND SAVINGS			$		$
N. TOTAL		16,099	$ 210,818		$ 2,487,517

3. NON ENERGY SAVINGS (+) OR COST (-):

A. ANNUAL RECURRING (+/-)
(1) DISCOUNT FACTOR (TABLE A)
(2) DISCOUNTED SAVINGS/COST (3A X 3A1) 25,006

B. NON RECURRING SAVINGS (+) OR COST (-)

ITEM	SAVINGS(+) COST(-)(1)	YEAR OF OCCUR. (2)	DISCOUNT FACTOR(3)	DISCOUNTED SAVINGS(+)COST(-)(4)
a.	$			$
b.	$			$
c.	$			$
d. TOTAL				$ (7,823)

C. TOTAL NON ENERGY DISCOUNTED SAVINGS (3A2+3Bd4) $17,183

4. SIMPLE PAYBACK 1G/(2N3+3A):	2.35 YEARS
5. TOTAL NET DISCOUNTED SAVINGS (2N5+3C):	$2,504,700
6. SAVINGS TO INVESTMENT RATION (SIR) 5/1G:	5.05
7. ADJUSTED INTERNAL RATE OF RETURN (AIRR):	------

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Low Flow Shower Heads

LIFE CYCLE COST ANALYSIS SUMMARY
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)

LOCATION: Fort A.P. Hill, Virginia REGION: 3 PROJECT NO.: DACA 31-89-C-0198
PROJECT TITLE: Fort A.P. Hill- Energy Engineering Analysis Program FISCAL YEAR: 1994
DISCRETE PORTION NAME: Low Flow Shower Heads
ANALYSIS DATE: January 1994 ECONOMIC LIFE (YRS 20 PREPARER: JJS

1. INVESTMENT COSTS:

A. CONSTRUCTION COST	$	3,130	
B. SIOH	$	172	
C. DESIGN COST	$	188	
D. TOTAL COST (1A+1B+1C)	$	3,490	
E. SALVAGE VALUE OF EXISTING EQUIPMENT			
F. PUBLIC UTILITY COMPANY REBATE			
G. TOTAL INVESTMENT (1D-1E-1F)			$3,490

2. ENERGY SAVINGS (+)/COST(-):

DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS- Oct 1992

ENERGY SOURCE	COST $/MBTU(1)	SAVING(S) MBTU/YR(2)	ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELEC	$20.67	453.0	$ 9,364	14.65	$ 137,175
B. DIST	$5.69		$		$
C. RESID			$		$
D. NG			$		$
E. LPG	$7.76		$		$
F. COAL			$		$
G. SOLAR			$		$
H. GEOTH			$		$
I. BIOMA			$		$
J. REFUS			$		$
K. WIND			$		$
L. OTHER			$		$
M. DEMAND SAVINGS			$		$
N. TOTAL		453	$ 9,364		$ 137,175

3. NON ENERGY SAVINGS (+) OR COST (-):

A. ANNUAL RECURRING (+/-)
(1) DISCOUNT FACTOR (TABLE A)
(2) DISCOUNTED SAVINGS/COST (3A X 3A1)

B. NON RECURRING SAVINGS (+) OR COST (-)

ITEM	SAVINGS(+) COST(-)(1)	YEAR OF OCCUR. (2)	DISCOUNT FACTOR(3)	DISCOUNTED SAVINGS(+)COST(-)(4)
a.	$			$
b.	$			$
c.	$			$
d. TOTAL				$

C. TOTAL NON ENERGY DISCOUNTED SAVINGS (3A2+3Bd4)

4. SIMPLE PAYBACK 1G/(2N3+3A+(3Bd1/ECONOMIC LIFE)):	0.37 YEARS
5. TOTAL NET DISCOUNTED SAVINGS (2N5+3C):	$137,175
6. SAVINGS TO INVESTMENT RATION (SIR) 5/1G:	39.31
7. ADJUSTED INTERNAL RATE OF RETURN (AIRR):	20.96%

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CONSTRUCTION COST ESTIMATE	PREPARED: March 1994	SHEET 1 OF 2
PROJECT: Energy Savings Oppurtunity Survey	CONTRACT NO.: DACA 31-89-C-0198	
LOCATION: Fort A.P. Hill, Virginia		
AE PROJECT NO.: 92008	ESTIMATOR: JS	PRELIM:
AE: Engineering Applications Consultants, P.C.	CHECKED BY: VP	FINAL: X

SUMMARY: Low Flow Shower Heads

ITEM	QUANTITY		MATERIAL		LABOR		TOTAL COST
	NO.	MEAS	UNIT	COST	UNIT	COST	
Low Flow Shower Heads							
SUBGROUP							
Administration Buildings	3	EA	25.00	75	7.00	21	96
Dinning Facilities		EA	25.00		7.00		
Housing Facilities	67	EA	25.00	1,675	7.00	469	2,144
SUB-TOTAL				1,750		490	2,240

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CONSTRUCTION COST ESTIMATE

PREPARED: March 1994 SHEET 2 OF 2

PROJECT: Energy Savings Oppurtunity Survey

CONTRACT NO.: DACA 31-89-C-0198

LOCATION: Fort A.P. Hill, Virginia
AE PROJECT NO.:
AE: Engineering Applications Consultants, P.C.

ESTIMATOR: JS PRELIM:
CHECKED BY: VP FINAL: X

SUMMARY: Low Flow Shower Heads

ITEM	QUANTITY		MATERIAL		LABOR		TOTAL COST
	NO.	MEAS	UNIT	COST	UNIT	COST	
SUBTOTAL PREV. PAGE				1,750		490	2,240
MARK-UP ON LABOR SUB-TOTAL	21.0%			---		103	103 2,343
TAXES ON MATERIAL SUB-TOTAL	5.0%			88		---	88 2,430
OVERHEAD SUB-TOTAL	15.0%						365 2,795
PROFIT SUB-TOTAL	12.0%						335 3,130
PRIME MARK-UP ON SUB SUB-TOTAL							3,130
GRAND TOTAL							3,100

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1/1

	Dinning	Housing	Admin	Field Latrines
Building Number	172	174	1,253	412
Floor Area (Ft**2)	4,272	4,800	5,000	143
Group Floor Area (Ft**2)	4,272	53,820	11,800	3,931

Existing Energy Usage- Bldg 1253	
MBtu/Yr	280.7
$/Yr	5,183
Existing Energy Usage- Bldg 174	
MBtu/Yr	378.7
$/Yr	6,992
Existing Energy Usage- Bldg 172	
MBtu/Yr	438.1
$/Yr	8,088

ECO	ECO Savings		Average Study Blg Savings		Average Study Blg Cost		Average Group Savings		Average Group Cost		No. of	Units per Study	Total
Subgroup A-1- Study Blg 1253	MBtu/Yr	$/Yr	MBtu/ft**2	$/Yr/ft**2	Materials $	Labor $	MBtu/Yr	$/Yr	Materials $	Labor $	Units Per Study Bldg	Blg Floor Area	Units Per Group
Low Flow Shower Heads	11.2	231	0.0031	0.0631	25	7	36.1	745	81	23	1	0.000273	3
Occupancy Sensors	31	573	0.0085	0.1566	616	56	99.9	1,847	1,986	181	8	0.002186	26
Compact Fluorescent Lights	6.93	127	0.0019	0.0347	192	4	22.3	409	619	13	8	0.002186	26
Energy Saving Fluorescent Lamps	22.8	420	0.0062	0.1148	497	216	73.5	1,354	1,602	696	144	0.039344	464
Exit Signs	5.38	150	0.0015	0.0410	500	100	17.3	484	1,612	322	4	0.001093	13
F32 T-8 Lighting System	39.7	733	0.0108	0.2003	2317	607	128.0	2,363	7,470	1,957	53	0.014481	171
Economizer Controls	24	444	0.0066	0.1213	2258	1280	77.4	1,431	7,280	4,127	1	0.000273	3
Daylight Dimming Controls	6.2	113	0.0017	0.0309	720	400	20.0	364	2,321	1,290	4	0.001093	13
Water Heater Timers	0.112	3	0.0000	0.0008	40	18	0.4	10	129	58	1	0.000273	3
Water Heater Insulation	1.17	24	0.0003	0.0066	25	18	3.8	77	81	58	1	0.000273	3

ECO	ECO Savings MBtu/Yr	ECO Savings $/Yr	Average Study Blg Savings MBtu/ft**2	Average Study Blg Savings $/Yr/ft**2	Average Study Blg Cost Materials $/ft**2	Average Study Blg Cost Labor $/ft**2	Average Group Savings MBtu/Yr	Average Group Savings $/Yr	Average Group Cost Materials $	Average Group Cost Labor $	No. of Units Per Study Bldg	Units per Study Blg Floor Area	Total Units Per Group
Subgroup B-1- Study Blg 174													
Low Flow Shower Heads	37.2	769	0.0078	0.1602	150	42	417.1	8,622	1,682	471	6	0.00125	67
Compact Fluorescent Lighting	41.9	774	0.0087	0.1613	322	7	469.8	8,678	3,610	78	14	0.002917	157
Occupancy Sensors	55.4	1021	0.0115	0.2127	1078	98	621.2	11,448	12,087	1,099	14	0.002917	157
Water Heater Timer	1.13	23	0.0002	0.0048	40	18	12.7	258	449	202	1	0.000208	11
Energy Savings Fluorescent Lamps	19.6	361	0.0041	0.0752	490	213	219.8	4,046	5,494	2,388	142	0.029583	1,592
F32 T-8 Lighting System	12	221	0.0025	0.0460	2904	726	134.6	2,478	32,561	8,140	33	0.006875	370
Water Heater Insulation	1.17	24	0.0002	0.0050	25	18	13.1	269	280	202	1	0.000208	18

ECO	ECO Savings MBtu/Yr	ECO Savings $/Yr	Average Study Blg Savings MBtu/ft**2	Average Study Blg Savings $/Yr/ft**2	Average Study Blg Cost Materials $	Average Study Blg Cost Labor $	Average Group Savings MBtu/Yr	Average Group Savings $/Yr	Average Group Cost Materials $	Average Group Cost Labor $	No. of Units Per Study Bldg	Units per Study Blg Floor Area	Total Units Per Group
Subgroup D-1- Study Blg 172													
Compact Fluorescent Lights	4.12	76	0.0010	0.0178	142	3	4.1	76	142.00	3.00	6	0.001404	6
Energy Savings Fluorescent Lamps	3.68	68	0.0009	0.0159	131	57	3.7	68	131.00	57.00	38	0.008895	38
Occupancy Sensors	15.46	285	0.0036	0.0667	1213	284	15.5	285	1,213.00	284.00	15	0.003511	15
Exit Sign Retrofit	14.08	260	0.0033	0.0609	1375	275	14.1	260	1,375.00	275.00	11	0.002575	11
Water Heater Timers	0.5	9	0.0001	0.0021	40	18	0.5	9	40.00	18.00	1	0.000234	1
DayLight Dimming Controls	0.56	10	0.0001	0.0023	180	100	0.6	10	180.00	100.00	1	0.000234	1

ECO	ECO Savings MBtu/Yr	ECO Savings $/Yr	Average Study Blg Savings MBtu/ft**2	Average Study Blg Savings $/Yr/ft**2	Average Study Blg Cost Materials $	Average Study Blg Cost Labor $	Average Group Savings MBtu/Yr	Average Group Savings $/Yr	Average Group Cost Materials $	Average Group Cost Labor $	No. of Units Per Study Bldg	Units per Study Blg Floor Area	Total Units Per Group
Subgroup E-2 Latrines													
Compact Flourescent Lights	6.38	117	0.0446	0.8182	23	2	175.4	3,216	632.26	54.98	4	0.027972	119
Occupancy Sensors	2.12	40	0.0148	0.2797	154	14	58.3	1,100	4,233.38	384.85	2	0.013986	60

New Buildings List- Buildings built after 1985 Fort A.P. Hill

SUBGROUP A-1

Bldg. No	Description		Floor Area (Ft**2)
1247	Entomology Facility		1,800
1252	General Inst. Bldg		5,000
1253	Range Control Bldg		5,000
		TOTAL	11,800

SUBGROUP B-1

Bldg. No	Description		Floor Area (Ft**2)
174	Guest House		4,800
290	Log Cabin Bullocks Lake		1,056
1350	FH NCO & ENL, QTRS 8		7,256
1351	FH NCO & ENL, QTRS 6		7,256
1352	FH NCO & ENL, QTRS 4		7,256
1353	FH NCO & ENL, QTRS 2		3,804
1354	FH Colonel, QTRS 1		2,553
1355	CO Grade & WO, QTRS 3		4,846
1356	FH NCO & ENL, QTRS 5		7,737
1357	FH NCO & ENL, QTRS 7		7,256
		TOTAL	53,820

SUBGROUP D-1

Bldg. No	Description		Floor Area (Ft**2)
172	Open Dinning NCO		4,272
		TOTAL	4,272

SUBGROUP E-1

Bldg. No	Description		Floor Area (Ft**2)
1241	Detached Latrine/Shwr		533

SUBGROUP E-2

Bldg. No	Description		Floor Area (Ft**2)
412	Detached Latrine TA12		143
413	Detached Latrine TA12		143
529	Detached Latrine Area 15		90
531	Detached Latrine TA15		143
733	Detached Latrine TNG 18		90
745	Detached Latrine TNG 14		144
746	Detached Latrine Rapp. Compound		144
748	Detached Latrine TA 18		143
826	Detached Latrine Range 42		143
828	Detached Latrine TNG 28		144
839	Detached Latrine at Repell. Twr		143
924	Detached Latrine		108
928	Detached Latrine		144
1008	Detached Latrine- Range 25		143
1024	Detached Latrine-Range 24		144
1108	Detached Latrine-Range 28P		144
1109	Detached Latrine-Range 28P		144
1110	Detached Latrine-Range 28P		144
1114	Detached Latrine		144
1116	Detached Latrine-Range 33		143
1202	Detached Latrine- Range 7		143
1254	Detached Latrine-Range 37		143
1256	Detached Latrine		108
1263	Detached Latrine-Range 6		143
1403	Detached Latrine-Tr Area 5		90
1405	Detached Latrine-Tr Area 3		90
1428	Detached Latrine-Tr Area 3		144
1619	Detached Latrine-Tr Area 21		90
1670	Detached Latrine-Tr Area 21		144
S 1272	Detached Latrine- Range 33		108
		TOTAL	3,931

Compact Fluorescent Lights

LIFE CYCLE COST ANALYSIS SUMMARY
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)

LOCATION: Fort A.P. Hill, Virginia REGION: 3 PROJECT NO.: DACA 31-89-C-0198
PROJECT TITLE: Fort A.P. Hill- Energy Engineering Analysis Program FISCAL YEAR: 1994
DISCRETE PORTION NAME: Replace Incandescent Lighting w/Compact Fluorescent Lighting
ANALYSIS DATE: January 1994 ECONOMIC LIFE (YRS 15 PREPARER: JJS

1. INVESTMENT COSTS:

A. CONSTRUCTION COST	$	9,157	
B. SIOH	$	504	
C. DESIGN COST	$	549	
D. TOTAL COST (1A+1B+1C)	$	10,210	
E. SALVAGE VALUE OF EXISTING EQUIPMENT			
F. PUBLIC UTILITY COMPANY REBATE			
G. TOTAL INVESTMENT (1D-1E-1F)			$10,210

2. ENERGY SAVINGS (+)/COST(-):

DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS- Oct 1992

ENERGY SOURCE	COST $/MBTU(1)	SAVING(S) MBTU/YR(2)		ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)		DISCOUNTED SAVINGS(5)
A. ELEC	$20.67	672.0	$	13,890	11.77	$	163,488
B. DIST	$5.69		$			$	
C. RESID			$			$	
D. NG			$			$	
E. LPG	$7.76		$			$	
F. COAL			$			$	
G. SOLAR			$			$	
H. GEOTH			$			$	
I. BIOMA			$			$	
J. REFUS			$			$	
K. WIND			$			$	
L. OTHER			$			$	
M. DEMAND SAVINGS			$			$	
N. TOTAL		672	$	13,890		$	163,488

3. NON ENERGY SAVINGS (+) OR COST (-):

A. ANNUAL RECURRING (+/-)	$2,910		
(1) DISCOUNT FACTOR (TABLE A)		11.12	
(2) DISCOUNTED SAVINGS/COST (3A X 3A1)			$32,359

B. NON RECURRING SAVINGS (+) OR COST (-)

ITEM		SAVINGS(+) COST(-)(1)	YEAR OF OCCUR. (2)	DISCOUNT FACTOR(3)		DISCOUNTED SAVINGS(+)COST(-)(4)
a.Comp.Fluor	$	-7700	3	0.890	$	-6853
b.Comp.Fluor	$	-7700	6	0.790	$	-6083
c.Comp.Fluor	$	-7700	9	0.700	$	-5390
d.Comp.Fluor	$	-7700	12	0.620	$	-4774
d. TOTAL		-30800			$	-23100

C. TOTAL NON ENERGY DISCOUNTED SAVINGS (3A2+3Bd4) $9,259

4. SIMPLE PAYBACK 1G/(2N3+3A+(3Bd1/ECONOMIC LIFE)): 0.69 YEARS
5. TOTAL NET DISCOUNTED SAVINGS (2N5+3C): $172,747
6. SAVINGS TO INVESTMENT RATION (SIR) 5/1G: 16.92
7. ADJUSTED INTERNAL RATE OF RETURN (AIRR): 21.58%

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ENGINEERING ANALYSIS

Sheet ____ of ____

By: JS

REPLACE INCANDESCENT W/ COMPACT FLUORESCENT

Project: Fort A. P. Hill ESOS Date: 2-28-94

Contract No.: DACA 31-89-C-0198 EAC Project No.: 92008

LAMP ECONOMICAL LIFE OVER 15 YRS

OPERATING HOURS = $\frac{10\text{ HRS}}{\text{day}} \times \frac{5\text{ days}}{\text{WK}} \times \frac{52\text{ WKS}}{\text{YR}} = 2600\text{ HRS/YR}$

A-19 Incandescent LAMP LIFE = 750 hrs

Useful Life $= \frac{750\text{ hrs}}{2600\text{ HRS/yr}} = .3\text{ yr}$

ANNUAL MAINTENANCE COSTS:

308 LAMPS $\times \frac{3\text{ changes}}{\text{YR}} \times \frac{3.15}{\text{bulb \& FIXTURE CLEAN}} = \$2910/\text{yr}$

COMPACT FLUORESCENT (PL) LAMPS Avg LIFE = 10,000 HRS

Useful LIFE $= \frac{10{,}000\text{ HRS}}{2600\text{ HRS/yr}} = 3.85$ yrs (use 3 yrs)

ANNUAL MAINTENANCE: (OVER 15 yrs) - change lamps in yrs 3, 6, 9, 12

308 LAMPS $\times$ 1 change $\times \frac{\$25.00}{\text{LAMP \& FIXTURE CLEAN}} = 7{,}700$

CONSTRUCTION COST ESTIMATE

PREPARED: March 1994 SHEET 1 OF 2

PROJECT: Energy Savings Oppurtunity Survey

CONTRACT NO.: DACA 31-89-C-0198

LOCATION: Fort A.P. Hill, Virginia
AE PROJECT NO.: 92008
AE: Engineering Applications Consultants, P.C.

ESTIMATOR: JS PRELIM:
CHECKED BY: VP FINAL: X

SUMMARY: Install Compact Fluorescent Lights

ITEM	QUANTITY		MATERIAL		LABOR		TOTAL
	NO.	MEAS	UNIT	COST	UNIT	COST	COST
Replace Incandescent Lighting W/Compact Fl							
SUBGROUP							
Administration Buildings							
18 Watt Quad Fl. (LCFP18)	26	EA	23.00	598	0.50	13	611
Dinning Facilities							
15 Watt Compact Fl (LEL15)	2	EA	25.00	50	0.50	1	51
18 Watt Quad Fl. (LCFP18)	4	EA	23.00	92	0.50	2	94
Housing Facilities							
18 Watt Quad Fl. (LCFP18)	157	EA	23.00	3,611	0.50	79	3,690
Field Latrines							
18 Watt Quad Fl. (LCFP18)	119	EA	23.00	2,737	0.50	60	2,797
SUB-TOTAL				7,088		155	7,243

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CONSTRUCTION COST ESTIMATE

PREPARED: March 1994 | SHEET 2 OF 2

PROJECT: Energy Savings Oppurtunity Survey

CONTRACT NO.: DACA 31-89-C-0198

LOCATION: Fort A.P. Hill, Virginia
AE PROJECT NO.:
AE: Engineering Applications Consultants, P.C.

ESTIMATOR: JS | PRELIM:
CHECKED BY: VP | FINAL: X

SUMMARY: Install Compact Fluorescent Lights

ITEM	QUANTITY NO.	QUANTITY MEAS	MATERIAL UNIT	MATERIAL COST	LABOR UNIT	LABOR COST	TOTAL COST
SUBTOTAL PREV. PAGE				7,088		155	7,243
MARK-UP ON LABOR SUB-TOTAL	21.0%			—		33	33 7,276
TAXES ON MATERIAL SUB-TOTAL	5.0%			354		—	354 7,630
OVERHEAD SUB-TOTAL	15.0%						1,144 8,774
PROFIT SUB-TOTAL	12.0%						1,053 9,827
PRIME MARK-UP ON SUB SUB-TOTAL							9,827
GRAND TOTAL							9,800

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Building Number	Dinning 172	Housing 174	Admin 1,253	Field Latrines 412
Floor Area (Ft**2)	4,272	4,800	5,000	143
Group Floor Area (Ft**2)	4,272	53,820	11,800	3,931

Existing Energy Usage- Bldg 1253	
MBtu/Yr	280.7
$/Yr	5,183

Existing Energy Usage- Bldg 174	
MBtu/Yr	378.7
$/Yr	6,992

Existing Energy Usage- Bldg 172	
MBtu/Yr	438.1
$/Yr	8,088

ECO	ECO Savings		Average Study Blg Savings		Average Study Blg Cost		Average Group Savings		Average Group Cost		No. of Units Per Study Bldg	Units per Study Blg Floor Area	Total Units Per Group
Subgroup A-1- Study Blg 1253	MBtu/Yr	$/Yr	MBtu/ft**2	$/Yr/ft**2	Materials $	Labor $	MBtu/Yr	$/Yr	Materials $	Labor $			
Low Flow Shower Heads	11.2	231	0.0031	0.0631	25	7	36.1	745	81	23	1	0.000273	3
Occupancy Sensors	31	573	0.0085	0.1566	616	56	99.9	1,847	1,986	181	8	0.002186	26
Compact Fluorescent Lights	6.93	127	0.0019	0.0347	192	4	22.3	409	619	13	8	0.002186	26
Energy Saving Fluorescent Lamps	22.8	420	0.0062	0.1148	497	216	73.5	1,354	1,602	696	144	0.039344	464
Exit Signs	5.38	150	0.0015	0.0410	500	100	17.3	484	1,612	322	4	0.001093	13
F32 T-8 Lighting System	39.7	733	0.0108	0.2003	2317	607	128.0	2,363	7,470	1,957	53	0.014481	171
Economizer Controls	24	444	0.0066	0.1213	2258	1280	77.4	1,431	7,280	4,127	1	0.000273	3
Daylight Dimming Controls	6.2	113	0.0017	0.0309	720	400	20.0	384	2,321	1,290	4	0.001093	13
Water Heater Timers	0.112	3	0.0000	0.0008	40	18	0.4	10	129	58	1	0.000273	3
Water Heater Insulation	1.17	24	0.0003	0.0066	25	18	3.8	77	81	58	1	0.000273	3

ECO	ECO Savings MBtu/Yr	ECO Savings $/Yr	Average Study Blg Savings MBtu/ft**2	Average Study Blg Savings $/Yr/ft**2	Average Study Blg Cost Materials $/ft**2	Average Study Blg Cost Labor $/ft**2	Average Group Savings MBtu/Yr	Average Group Savings $/Yr	Average Group Cost Materials $	Average Group Cost Labor $	No. of Units Per Study Bldg	Units per Study Blg Floor Area	Total Units Per Group
Subgroup B-1- Study Blg 174													
Low Flow Shower Heads	37.2	769	0.0078	0.1602	150	42	417.1	8,622	1,682	471	6	0.00125	67
Compact Fluorescent Lighting	41.9	774	0.0087	0.1613	322	7	469.8	8,678	3,610	78	14	0.002917	157
Occupancy Sensors	55.4	1021	0.0115	0.2127	1078	98	621.2	11,448	12,087	1,099	14	0.002917	157
Water Heater Timer	1.13	23	0.0002	0.0048	40	18	12.7	258	449	202	1	0.000208	11
Energy Savings Fluorescent Lamps	19.6	361	0.0041	0.0752	490	213	219.8	4,048	5,494	2,388	142	0.029583	1,592
F32 T-8 Lighting System	12	221	0.0025	0.0460	2904	726	134.6	2,478	32,561	8,140	33	0.006875	370
Water Heater Insulation	1.17	24	0.0002	0.0050	25	18	13.1	269	280	202	1	0.000208	18

ECO	ECO Savings MBtu/Yr	ECO Savings $/Yr	Average Study Blg Savings MBtu/ft**2	Average Study Blg Savings $/Yr/ft**2	Average Study Blg Cost Materials $	Average Study Blg Cost Labor $	Average Group Savings MBtu/Yr	Average Group Savings $/Yr	Average Group Cost Materials $	Average Group Cost Labor $	No. of Units Per Study Bldg	Units per Study Blg Floor Area	Total Units Per Group
Subgroup D-1- Study Blg 172													
Compact Fluorescent Lights	4.12	76	0.0010	0.0178	142	3	4.1	76	142.00	3.00	6	0.001404	6
Energy Savings Fluorescent Lamps	3.68	68	0.0009	0.0159	131	57	3.7	68	131.00	57.00	38	0.008895	38
Occupancy Sensors	15.46	285	0.0036	0.0667	1213	284	15.5	285	1,213.00	284.00	15	0.003511	15
Exit Sign Retrofit	14.08	260	0.0033	0.0609	1375	275	14.1	260	1,375.00	275.00	11	0.002575	11
Water Heater Timers	0.5	9	0.0001	0.0021	40	18	0.5	9	40.00	18.00	1	0.000234	1
DayLight Dimming Controls	0.56	10	0.0001	0.0023	180	100	0.6	10	180.00	100.00	1	0.000234	1

ECO	ECO Savings MBtu/Yr	ECO Savings $/Yr	Average Study Blg Savings MBtu/ft**2	Average Study Blg Savings $/Yr/ft**2	Average Study Blg Cost Materials $	Average Study Blg Cost Labor $	Average Group Savings MBtu/Yr	Average Group Savings $/Yr	Average Group Cost Materials $	Average Group Cost Labor $	No. of Units Per Study Bldg	Units per Study Blg Floor Area	Total Units Per Group
Subgroup E-2 Latrines													
Compact Flourescent Lights	6.38	117	0.0446	0.8182	23	2	175.4	3,216	632.28	54.98	4	0.027972	119
Occupancy Sensors	2.12	40	0.0148	0.2797	154	14	58.3	1,100	4,233.38	384.85	2	0.013986	60

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New Buildings List- Buildings built after 1985 Fort A.P. Hill

SUBGROUP A-1

Bldg. No	Description		Floor Area (Ft**2)
1247	Entomology Facility		1,800
1252	General Inst. Bldg		5,000
1253	Range Control Bldg		5,000
		TOTAL	11,800

SUBGROUP B-1

Bldg. No	Description		Floor Area (Ft**2)
174	Guest House		4,800
290	Log Cabin Bullocks Lake		1,056
1350	FH NCO & ENL, QTRS 8		7,256
1351	FH NCO & ENL, QTRS 6		7,256
1352	FH NCO & ENL, QTRS 4		7,256
1353	FH NCO & ENL, QTRS 2		3,804
1354	FH Colonel, QTRS 1		2,553
1355	CO Grade & WO, QTRS 3		4,846
1356	FH NCO & ENL, QTRS 5		7,737
1357	FH NCO & ENL, QTRS 7		7,256
		TOTAL	53,820

SUBGROUP D-1

Bldg. No	Description		Floor Area (Ft**2)
172	Open Dinning NCO		4,272
		TOTAL	4,272

SUBGROUP E-1

Bldg. No	Description	Floor Area (Ft**2)
1241	Detached Latrine/Shwr	533

SUBGROUP E-2

Bldg. No	Description		Floor Area (Ft**2)
412	Detached Latrine TA12		143
413	Detached Latrine TA12		143
529	Detached Latrine Area 15		90
531	Detached Latrine TA15		143
733	Detached Latrine TNG 18		90
745	Detached Latrine TNG 14		144
746	Detached Latrine Rapp. Compound		144
748	Detached Latrine TA 18		143
826	Detached Latrine Range 42		143
828	Detached Latrine TNG 28		144
839	Detached Latrine at Repell. Twr		143
924	Detached Latrine		108
928	Detached Latrine		144
1008	Detached Latrine- Range 25		143
1024	Detached Latrine-Range 24		144
1108	Detached Latrine-Range 28P		144
1109	Detached Latrine-Range 28P		144
1110	Detached Latrine-Range 28P		144
1114	Detached Latrine		144
1116	Detached Latrine-Range 33		143
1202	Detached Latrine- Range 7		143
1254	Detached Latrine-Range 37		143
1256	Detached Latrine		108
1263	Detached Latrine-Range 6		143
1403	Detached Latrine-Tr Area 5		90
1405	Detached Latrine-Tr Area 3		90
1428	Detached Latrine-Tr Area 3		144
1619	Detached Latrine-Tr Area 21		90
1670	Detached Latrine-Tr Area 21		144
S 1272	Detached Latrine- Range 33		108
		TOTAL	3,931

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Night Setback

LIFE CYCLE COST ANALYSIS SUMMARY
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)

LOCATION: Fort A.P. Hill, Virginia REGION: 3 PROJECT NO.: DACA 31-89-C-0198
PROJECT TITLE: Fort A.P. Hill- Energy Engineering Analysis Program FISCAL YEAR: 1994
DISCRETE PORTION NAME: Night Set-Back
ANALYSIS DATE: January 1994 ECONOMIC LIFE (YRS) 15 PREPARER: JJS

1. INVESTMENT COSTS:

A. CONSTRUCTION COST	$	37,631	
B. SIOH	$	2,070	
C. DESIGN COST	$	2,258	
D. TOTAL COST (1A+1B+1C)	$	41,959	
E. SALVAGE VALUE OF EXISTING EQUIPMENT			
F. PUBLIC UTILITY COMPANY REBATE			
G. TOTAL INVESTMENT (1D-1E-1F)			$41,959

2. ENERGY SAVINGS (+)/COST(-):

DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS- Oct 1992

ENERGY SOURCE	COST $/MBTU(1)	SAVING(S) MBTU/YR(2)		ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)		DISCOUNTED SAVINGS(5)
A. ELEC	$20.67	768.7	$	15,889	11.77	$	187,014
B. DIST	$5.69	5,544.5	$	31,548	13.83	$	436,312
C. RESID			$			$	
D. NG			$			$	
E. LPG	$7.76		$			$	
F. COAL			$			$	
G. SOLAR			$			$	
H. GEOTH			$			$	
I. BIOMA			$			$	
J. REFUS			$			$	
K. WIND			$			$	
L. OTHER			$			$	
M. DEMAND SAVINGS			$			$	
N. TOTAL		6,313	$	47,437		$	623,326

3. NON ENERGY SAVINGS (+) OR COST (-):

A. ANNUAL RECURRING (+/-)	($2,210)		
(1) DISCOUNT FACTOR (TABLE A)		10.56	
(2) DISCOUNTED SAVINGS/COST (3A X 3A1)			($23,338)

B. NON RECURRING SAVINGS (+) OR COST (-)

ITEM	SAVINGS(+) COST(-)(1)	YEAR OF OCCUR. (2)	DISCOUNT FACTOR(3)	DISCOUNTED SAVINGS(+)COST(-)(4)
a.	$			$
b.	$			$
c.	$			$
d. TOTAL				$

C. TOTAL NON ENERGY DISCOUNTED SAVINGS (3A2+3Bd4) ($23,338)

4. SIMPLE PAYBACK 1G/(2N3+3A+(3Bd1/ECONOMIC LIFE)): 0.93 YEARS
5. TOTAL NET DISCOUNTED SAVINGS (2N5+3C): $599,988
6. SAVINGS TO INVESTMENT RATION (SIR) 5/1G: 14.30
7. ADJUSTED INTERNAL RATE OF RETURN (AIRR): 20.18%

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CONSTRUCTION COST ESTIMATE	Date Prepared: 1/27/94	Reference: MMM Design Group/ 1992 R.S. Means
Activity and Location: Energy Savings Opportunity Survey Fort A. P. Hill, Virginia	Constr. Contact No. DACA 31-89-C-0198	I.D. No.
	Estimated By: EAC, P.C.	Category Code
Project: Night Set-Back	Status: Final	Job Order No.

ITEM DESCRIPTION	QUANTITY		PRIME CONTRACTOR				SUBCONTRACTOR				TOTAL COST
			MATERIAL COST		LABOR COST		MATERIAL COST		LABOR COST		
	NUMBER	UNIT	UNIT COST	TOTAL	UNIT COST	TOTAL	UNIT COST	TOTAL	UNIT COST	TOTAL	
Installation of new solid state type thermostat w/wiring	85.00	EA	156.00	13,260	153.00	13,005					26,265
SUB - TOTAL				$13,260		$13,005					$26,265

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CONSTRUCTION COST ESTIMATE	Date Prepared: 1/27/94	
Activity and Location: Energy Savings Opportunity Survey Fort A. P. Hill, Virginia	Constr. Contact No. DACA 31-89-C-0198	I.D. No.
	Estimated By: EAC, P.C.	Category Code
Project: Night Set-Back	Status: Final	Job Order No.

ITEM DESCRIPTION	QUANTITY		PRIME CONTRACTOR				SUBCONTRACTOR				TOTAL COST
			MATERIAL COST		LABOR COST		MATERIAL COST		LABOR COST		
SUMMARY	NUMBER	UNIT	UNIT COST	TOTAL	UNIT COST	TOTAL	UNIT COST	TOTAL	UNIT COST	TOTAL	
Subtotal				13,260		13,005					
DIRECT COSTS				13,260		13,005					
SUBTOTAL (DIRECT COSTS)				13,260		13,005					
Material Tax & Labor Taxes			5.0%	663	21.0%	2,731	5.0%		21.0%		
Overhead			15.0%	1,989	15.0%	1,951	15.0%		15.0%		
SUBTOTAL				15,912		17,687					
Profit			12.0%	1,909	12.0%	2,122	12.0%		12.0%		
SUBTOTAL				17,821		19,809					
Prime Overhead on Sub							5.0%		5.0%		
SUBTOTAL											
Prime Profit on Sub							5.0%		5.0%		
TOTAL COST				17,821		19,809					37,631

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DESIGN ANALYSIS

☒ BUDGET
☐ PRELIMINARY
☐ FINAL
☐ OTHER

PROJECT NAME: EEAP - A P HILL	PROJECT PART: NIGHT-SET-BACK	SPEC. DIVISION: THERMOSTATS
DEPARTMENT: MECHANICAL	COMPUTED BY: CTW DATE: 9/15/82	JOB NO: 4417.02
SHEET NO: OF:	CHECKED BY: DATE:	SHEET NO: OF:

GROUP	BLDG.	FT^2	NO. OF T'STATS
A	126	2490	1
B	1528	7563	1
C	313	5234	2
C	1290	9306	2
D	820	6176	1
D	179	6275	2
E	821	7056	2

SET-BACK THERMOSTAT REQUIREMENTS CANNOT BE ADEQUATELY ESTIMATED ON A PER-SQUARE-FOOT GROUP BASIS. IT IS ESTIMATED THAT EACH BUILDING WILL REQUIRE 1 T'STAT FOR EVERY 5000 FT^2 OF FLOOR AREA, OR PART THERE-OF. THIS CRITERIA PROVIDES AN ESTIMATE OF 89 T'STATS FOR 72 BUILDINGS.

MAINTENANCE

IT IS ESTIMATED THAT EACH T'STAT WILL REQUIRE 1 HR/YR FOR CALIBRATION. FOR EACH OF 14 YRS (INITIALLY CALIBRATED).

UNESCALATED COST: $17 x 89 = $1513 (MEAN'S 1982)

ESCALATED COST: $\$1513 \times 1.07^2 \times 1.035 \times (7.729/7.960) = \$1741$

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ENGINEERING ANALYSIS

Sheet _____ of _____

By: _____

NIGHT SET BACK

Project: Fort A. P. Hill ESOS Date: 2-28-94

Contract No.: DACA 31-89-C-0198 EAC Project No.: 92008

BLg	Subgroup	AREA (FT2)
101	A-1	5080
105	A-1	2273
126	A-1	2634
127	A-1	2526
292	B-1	1056
293	B-1	1175
294	B-1	1175
1220	A-1	6464

AREA TO BE REMOVED PER GROUP

A-1 - 18,977

B-1 - 3,406

TSTATS = 22383 FT3/5000
= 4

REDUCE # OF T STATS TO
85 INSTEAD OF 89

CALIBRATION ONCE PER YEAR FOR 14 (INITIALLY CALIBRATED) YEARS =
$26 x 85 = 2210

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DESIGN ANALYSIS

☐ BUDGET
☐ PRELIMINARY
☒ FINAL
☐ OTHER

PROJECT NAME: EEAP - A P HILL	PROJECT PART: NIGHT SET-BACK	SPEC. DIVISION:
DEPARTMENT: MECH	COMPUTED BY: CTN DATE: 5/9/82	JOB NO: 4717.02
SHEET NO: OF:	CHECKED BY: DATE:	SHEET NO: OF:

NIGHT SET-BACK

INVOLVED ADMINISTRATION & MESS HALL BLDGS:

		179	
		216	1262
113	135	224	1525
116	137	303	1527
121	144	304	1535
123	145	820	2001

10°F HEATING SET-BACK / COOLING SHUT-OFF : 1700 TO 0600

INVOLVED SHOPS

102	151	1214	1290
106 A	313	1224	1291
192	708	1226	

15 °F HEATING SET-BACK / COOLING SHUT-OFF : 1700 TO 0600

INVOLVED BARRACKS & LATRINES

117	146	254	310	1528
118	179		311	1529
119	205		506	1532
125	207		707	1533
130	208	305	801	1622
131	209	306	821	
132	227	308	1205	
133	253	309	1526	

5°F HEATING SET-BACK : 2400 TO 0600

FRM0C 31/0108

BUILDING GROUP ENERGY SAVINGS
NIGHT SETBACK

Sub Group	Synergy Adjustment Factor	Applied Group (SQ.-FT.)	Average Sub-Group Savings- BTU/FT^2-Yr			Total Sub-Group Savings MBTU/Yr		
			ELECTRIC	FUEL	TOTAL	ELECTRIC	FUEL	TOTAL
A-1	0.746	17,128	5,088	49,891	54,971	87.0	854.5	941.0
A-1W	0.803	9,344	3,737	11,093	14,829	28.0	83.2	111.0
B-1	0.673	43,560	1,190	27,357	28,547	51.8	1,191.0	1,242.8
B-1W	0.526	3,528	634	5,540	6,174	1.2	10.3	11.5
B-2	0.758	38,967	1,190	27,357	28,547	35.2	808.0	843.2
C-1	0.774	23,147	57	4,414	4,471	1.0	79.1	80.1
C-1W	0.584	3,644	114	593	707	0.2	1.3	1.5
C-2	0.894	11,364	1,934	4,137	6,071	19.7	42.0	61.7
D-1	0.917	15,043	32,560	85,860	118,420	449.1	1184.4	1633.5
D-2	0.877	18,176	4,598	73,981	78,579	73.3	1,179.3	1252.6
E-1	0.612	9,484	3,444	18,325	21,769	20.0	106.4	126.4
E-1W	0.964	3,033	736	1,729	2,465	2.2	5.0	7.2
TOTAL ENERGY SAVINGS BASED ON BLAST COMPUTER MODEL, SYNERGY ADJUSTED						768.7	5,544.5	6,313.2

W=WINTERIZED

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BUILDING GROUP ENERGY USAGE

NIGHT SET-BACK ONLY

SUB GROUP	STUDY BUILDING	AVERAGE SUB - GROUP BASIC BTU/FT^2 - YR.			AVERAGE SUB - GROUP WITH OPTION BTU/FT^2 - YR.		
		ELECTRIC	FUEL	TOTAL	ELECTRIC	FUEL	TOTAL
A-1	101, 126	83040	119426	202466	77952	69535	147487
A-1W	101, 126	49238	17775	67012	45501	6682	52183
B-1	SEE B-2						
B-1W	(1528)	34166	20772	54938	33532	15232	48764
B-2	1528	62964	123417	186381	61774	96060	157834
C-1	313	70902	89282	160184	70845	84868	155713
C-1W	313	37791	6057	43848	37677	5464	43141
C-2	1290	102396	38513	140909	100462	34376	134838
D-1	179	273699	225344	499043	241139	139484	380623
D-2	820	192940	468524	611464	138342	394543	532885
E-1	821	412543	245961	658504	409099	227636	636735
E-1W	821	229563	78515	308078	228827	76786	305613

W=WINTERIZED

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DESIGN ANALYSIS

☐ BUDGET
☐ PRELIMINARY
☒ FINAL
☐ OTHER

PROJECT NAME: EEAP – A. P. HILL	PROJECT PART: SYNERGY	SPEC. DIVISION: ADJUSTMENT FACTORS
DEPARTMENT: MECHANICAL	COMPUTED BY: CTW DATE: 9/16/82	JOB NO: 4417
SHEET NO: OF:	CHECKED BY: DATE:	SHEET NO: OF:

WHERE SEVERAL ENERGY CONSERVATION OPTIONS ARE INDEPENDENT OF EACH OTHER, THEIR COMBINED EFFECT IS THE SUM OF THEIR INDIVIDUAL EFFECTS. WHERE OPTIONS ARE DEPENDENT (AFFECTING THE SAME LOAD) THEIR COMBINED EFFECT IS THE PRODUCT OF THEIR INDIVIDUAL FRACTIONAL EFFECT. FOR EXAMPLE IF 2 OPTIONS WILL EACH REDUCE A GIVEN LOAD BY 60%, BOTH OPTIONS WILL NOT ELIMINATE 120% OF THE LOAD. INSTEAD THE NEW LOAD IS $.4 \times .4 = .16$ TIMES THE ORIGINAL LOAD. THE SECOND DEPENDENT OPTION REDUCES THE REMAINING LOAD, FOLLOWING IMPLEMENTATION OF THE FIRST OPTION.

SYNERGY ADJUSTMENT FACTORS, F_S

BUILDING OPTIONS FALL INTO 3 DEPENDENT GROUPS:

- ENVELOPE – CHANGES IN THIS GROUP ARE INDEPENDEN
- SYSTEMS – DEPENDENT AND INDEPENDENT
- OPERATIONS – DEPENDENT AND INDEPENDENT

EVALUATION OF INDIVIDUAL OPTIONS HAS SHOWN THAT ENVELOPE CHANGES ARE GENERALLY THE MOST COST EFFECTIVE. THEY ARE INDEPENDENT; E.G. CHANGES IN WALL INSULATION CHANGE WALL CONDUCTION WITHOUT INFLUENCING CEILING OR WINDOW LOSSES. ENVELOPE CHANGES HAVE EQUAL IMPACT ON BOTH HEATING AND COOLING LOADS.

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DESIGN ANALYSIS

☐ BUDGET
☐ PRELIMINARY
☒ FINAL
☐ OTHER

PROJECT NAME: EEAP	PROJECT PART: SYNERGY	SPEC. DIVISION: ADJUSTMENT FACTORS
DEPARTMENT: MECHANICAL	COMPUTED BY: CTW DATE: 9/16/82	JOB NO: 4917
SHEET NO: OF:	CHECKED BY: DATE:	SHEET NO: OF:

TO ADJUST SAVINGS FROM AN INDIVIDUAL OPTION:

ADJUSTED SAVINGS = SAVINGS X FRACTION OF LOAD (Fs) REMAINING, FOLLOWING ENVELOPE CHANGES

$$F_S = \frac{\text{ADJUSTED HEATING + COOLING LOAD (WITH OPTIONS)}}{\text{UNADJUSTED LOAD (WITHOUT ENVELOPE OPTIONS)}}$$

THE HEATING/COOLING LOADS HAVE BEEN PRESENTED IN FIGURES 2-13A THRU 2-13F AS PERCENTAGES OF THE TOTAL-LOAD. FOR EACH BUILDING GROUP.

SYNERGY ADJUSTMENT ACCOUNTS FOR THE EFFECTS OF PAST AND PROJECTED ENVELOPE ALTERATIONS FROM THE 1975 BASE MODEL.

FRJ066.0 .108

UNITS ARE MBTU - EXCEPT AS NOTED

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DESIGN ANALYSIS

☐ BUDGET
☐ PRELIMINARY
■ FINAL
☐ OTHER ______

PROJECT NAME: EEAP - A.P. HILL	PROJECT PART: SYNERGY	SPEC. DIVISION: ADJUSTMENT FACTORS
DEPARTMENT: MECHANICAL	COMPUTED BY: CTW DATE: 9/28/82	JOB NO: 4417.02
SHEET NO: OF:	CHECKED BY: DATE:	SHEET NO: OF:

BLDG. SUB-GROUP	A-1	A-1W	B-1	B-1W	B-2	C-1
1981 AREA - FT^2	111771	11499	77001	3528	38967	27250
1975 UNIT LOAD - BTU/FT^2	172257	49115	141414	44845	186381	160184
HEATING + COOLING/TOTAL	.859	.697	.725	.465	.771	.679
1981 HEATING + COOLING LOAD	16539	393.6	7895	73.6	5600	2964
ENVELOPE SAVINGS (MBTU)						
PAST STEEL SIDING	613	12.5	866	14.8	32	56
PAST CEILING INSULATION	179	—	55	.3	3	—
PAST STORM WINDOWS	246	9.9	95	.6	—	13
PAST THERMOPANE WINDOWS	65	1.8	12	—	—	—
NEW CEILING INSULATION	2469	42.3	104	1.0	89	71
NEW WALL INSULATION	313	16.2	1270	18.2	879	438
NEW STORM WINDOWS	109	—	87	—	284	51
NEW CAULK/W.STRIP	212	—	142	—	66	41
SYNERGY ADJUSTMENT						
SUB-TOTAL ENVELOPE SAVINGS	4206	77.7	2581	34.9	1353	670
ADJ. 1981 HTG + CLG LOAD	12333	315.9	5314	38.7	4247	2294
F_c = ADJ. LOAD/UNADJ. LOAD	.746	.803	.673	576	.758	.774

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DESIGN ANALYSIS

☐ BUDGET
☐ PRELIMINARY
■ FINAL
☐ OTHER

PROJECT NAME: EEAP- A.P. HILL	PROJECT PART: SYNERGY	SPEC. DIVISION: ADJUSTMENT FACTORS
DEPARTMENT: MECHANICAL	COMPUTED BY: CTW DATE: 9/28/82	JOB NO: 4417.02
SHEET NO: OF:	CHECKED BY: DATE:	SHEET NO: OF:

BLDG. SUB-GROUP	C-IW	C-2	D-1	D-2	E-1	E-IW
1981 AREA - FT^2	3644	22221	31997	18176	9484	10089
1975 UNIT LOAD - BTU/FT^2	43848	140909	499043	611464	658504	308078
HEATING + COOLING / TOTAL	.256	.409	.713	.572	.302	.131
1981 HEATING + COOLING LOAD	40.9	1281	11385	6357	1886	407.2
ENVELOPE SAVINGS (MBTU)						
PAST STEEL SIDING	5.1	1	349	—	—	12.8
PAST CEILING INSULATION	.6	—	—	—	—	—
PAST STORM WINDOWS	1.0	0	157	—	—	1.8
PAST THERMOPANE WINDOWS	—	—	—	—	—	—
NEW CEILING INSULATION	—	9	198	140	27	—
NEW WALL INSULATION	10.3	116	129	2281	625	—
NEW STORM WINDOWS	—	5	165	227	45	—
NEW CAULK/W.STRIP	—	5	49	133	35	—
SYNERGY ADJUSTMENT						
SUB-TOTAL ENVELOPE SAVINGS	17.0	136	947	781	732	14.6
ADJ. 1981 HTG + CLG LOAD	23.9	1145	10438	5576	1154	392.6
F_c = ADJ. LOAD / UNADJ. LOAD	.584	.894	.917	.877	.612	.964

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Automatic Controls For Heat Pumps

LIFE CYCLE COST ANALYSIS SUMMARY

ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)

LOCATION: Fort A.P. Hill, Virginia REGION: 3 PROJECT NO.: DACA 31-89-C-0198

PROJECT TITLE: Fort A.P. Hill- Energy Engineering Analysis Program FISCAL YEAR: 1994

DISCRETE PORTION NAME: Automatic Controls For Heatpumps

ANALYSIS DATE: January 1994 ECONOMIC LIFE (YRS 10 PREPARER: JJS

1. INVESTMENT COSTS:

A. CONSTRUCTION COST	$	47,820	
B. SIOH	$	2,630	
C. DESIGN COST	$	2,869	
D. TOTAL COST (1A+1B+1C)	$	53,319	
E. SALVAGE VALUE OF EXISTING EQUIPMENT			
F. PUBLIC UTILITY COMPANY REBATE			
G. TOTAL INVESTMENT (1D-1E-1F)			$53,319

2. ENERGY SAVINGS (+)/COST(-):

DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS- Oct 1992

ENERGY SOURCE	COST \$/MBTU(1)	SAVING(S) MBTU/YR(2)	ANNUAL \$ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELEC	$20.67	2,677.0	$ 55,334	8.39	$ 464,249
B. DIST	$5.69		$		$
C. RESID			$		$
D. NG			$		$
E. LPG	$7.76		$		$
F. COAL			$		$
G. SOLAR			$		$
H. GEOTH			$		$
I. BIOMA			$		$
J. REFUS			$		$
K. WIND			$		$
L. OTHER			$		$
M. DEMAND SAVINGS			$		$
N. TOTAL		2,677	$ 55,334		$ 464,249

3. NON ENERGY SAVINGS (+) OR COST (-):

A. ANNUAL RECURRING (+/-)	($2,100)		
(1) DISCOUNT FACTOR (TABLE A)		8.11	
(2) DISCOUNTED SAVINGS/COST (3A X 3A1)			($17,031)

B. NON RECURRING SAVINGS (+) OR COST (-)

ITEM	SAVINGS(+) COST(-)(1)	YEAR OF OCCUR. (2)	DISCOUNT FACTOR(3)	DISCOUNTED SAV-INGS(+)COST(-)(4)
a.	$			$
b.	$			$
c.	$			$
d. TOTAL				$

C. TOTAL NON ENERGY DISCOUNTED SAVINGS (3A2+3Bd4) ($17,031)

4. SIMPLE PAYBACK 1G/(2N3+3A+(3Bd1/ECONOMIC LIFE)):	1.00 YEARS
5. TOTAL NET DISCOUNTED SAVINGS (2N5+3C):	$447,218
6. SAVINGS TO INVESTMENT RATION (SIR) 5/1G:	8.39
7. ADJUSTED INTERNAL RATE OF RETURN (AIRR):	24.65%

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CONSTRUCTION COST ESTIMATE

PREPARED: March 1994 SHEET 1 OF 2

PROJECT: Energy Savings Oppurtunity Survey

CONTRACT NO.: DACA 31-89-C-0198

LOCATION: Fort A.P. Hill, Virginia
AE PROJECT NO.: 92008
AE: Engineering Applications Consultants, P.C.

ESTIMATOR: JS PRELIM:
CHECKED BY: VP FINAL: X

SUMMARY: Automatic Controls For Heat Pumps

ITEM	QUANTITY NO.	QUANTITY MEAS	MATERIAL UNIT	MATERIAL COST	LABOR UNIT	LABOR COST	TOTAL COST
Night Setback							
SUBGROUP							
Administration Buildings	30	EA	320.00	9,600	75.00	2,250	11,850
Dinning Facilities	7	EA	320.00	2,240	75.00	525	2,765
Housing Facilities	50	EA	320.00	16,000	75.00	3,750	19,750
SUB-TOTAL				27,840		6,525	34,365

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CONSTRUCTION COST ESTIMATE	PREPARED: March 1994	SHEET OF
PROJECT: Energy Savings Oppurtunity Survey		SHEET 2 OF 2
	CONTRACT NO.: DACA 31-89-C-0198	
LOCATION: Fort A.P. Hill, Virginia		
AE PROJECT NO.:	ESTIMATOR: JS	PRELIM:
AE: Engineering Applications Consultants, P.C.	CHECKED BY: VP	FINAL: X

SUMMARY: Automatic Controls For Heat Pumps

ITEM	QUANTITY		MATERIAL		LABOR		TOTAL COST
	NO.	MEAS	UNIT	COST	UNIT	COST	
SUBTOTAL PREV. PAGE				27,840		6,525 *p1938X	34,365
MARK-UP ON LABOR SUB-TOTAL	21.0%			----		1,370	1,370 35,735
TAXES ON MATERIAL SUB-TOTAL	5.0%			1,392		----	1,392 37,127
OVERHEAD SUB-TOTAL	15.0%						5,569 42,696
PROFIT SUB-TOTAL	12.0%						5,124 47,820
PRIME MARK-UP ON SUB SUB-TOTAL							47,820
GRAND TOTAL							47,800

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Energy Conservation Oppurtunity Summary: Automatic Controls for Heat Pumps

Study Building	Floor Area (Ft^2)	Existing Energy Usage		Total Energy Savings	
		MBtu/Yr	$/Yr	MBtu/Yr	$/Yr
172	4,800	438.1	8,088	109.1	2,255
174	4,272	378.7	6,992	74.3	1,536
1253	5,000	280.1	5,183	28.2	583

Sub Group	Study Bldg.	Applied Subgroup (Ft^2)	Average Study Building Savings		Total Applied Group Savings	
			Energy ($MBtu/Ft^2$-Yr)	$/$Ft^2$-Yr	Energy (MBtu/Yr)	$/Yr
Admin	1253	63,939	.0077	0.14	492.3	10,175
Housing	174	108,530	.0174	0.32	1,888.4	39,033
Dinning	172	13,040	.0227	0.42	296.0	6,118
TOTAL					2,676.7	55,327

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TABLE 1.0- HEAT PUMP BUILDINGS LIST FORT A.P. Hill [1]

ADMIN	FT^2	HOUSING	FT^2	DINING	FT^2
106	5,320	174	4,800	172	4,272
124	2,490	253	1,152	TO216	3,500
742	3,066	290	1,056	TO303	5,268
1220	6,464	292	1,056		
1252	5,000	293	1,175		
1253	5,000	294	1,175		
1650	3,363	1350	7,256		
SO137	1,740	1351	7,256		
TO101	5,080	1352	7,256		
TO102	1,604	1353	3,804		
TO105	2,273	1354	2,553		
TO114	1,440	1355	4,816		
TO120	2,100	1356	7,737		
TO122	1,455	1357	7,256		
TO126	2,634	SO201	3,106		
TO127	2,526	SO251	5,120		
TO128	2,668	SO254	1,526		
TO143	3,788	SO308	3,247		
TO163	1,920	SO313	1,300		
TO217	2,088	SO801	2,740		
TO714	1,920	TO117	2,400		
		TO118	2,400		
		TO119	2,400		
		TO125	2,541		
		TO130	861		
		TO131	861		
		TO132	800		
		TO133	800		
		TO142	3,384		
		TO146	2,200		
		TO207	444		
		TO208	5,220		
		TO209	532		
		TO211	995		
		TO215	3,061		
		TO252	576		
		TO712	960		
		TO713	960		
		TO715	960		
		T1205	788		
TOTAL	63,939		108,530		13,040

[1]SOURCE: Buildings list printout Fort A. P. Hill (New and Renovated Buildings)

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ANNUAL COMPONENT COSTS
Building : #172-Night Setback
Site : Fort AP Hill, Virginia
Prepared By : E.A.C., P.C. Burke, VA
Carrier Hourly Analysis Program

****

TABLE 1. COSTS BY COMPONENT

Component	<---- Annual Costs * ---> ($)	($/sqft)	% of Total
Air System Fans	582	0.116	9.6 %
Cooling Plants	579	0.116	9.5 %
Heating Plants	1,783	0.357	29.4 %
Pumps	0	0.000	0.0 %
>>> HVAC Subtotal	2,944	0.589	48.5 %
Lights	1,183	0.237	19.5 %
Other Electric	915	0.183	15.1 %
Miscellaneous Electric	0	0.000	0.0 %
Domestic Hot Water	1,032	0.206	17.0 %
>>> Non-HVAC Sub-total	3,130	0.626	51.5 %
>>> GRAND TOTAL	6,074	1.216	100.0 %

* Note: 1. Cost per unit floor area is based on the gross building floor area. For this building:
Gross floor area = 4,997 sqft
Conditioned floor area = 4,997 sqft

****

ANNUAL ENERGY COSTS

Building : #172-Night Setback 02-28-94
Site : Fort AP Hill, Virginia 6063092204
Prepared By : E.A.C., P.C. Burke, VA
Carrier Hourly Analysis Program

TABLE 1. COSTS BY ENERGY CATEGORY

HVAC Component	Annual Energy	<---- Annual Costs * --> ($)	($/sqft)	% of Total
Electric	46737 kWh	2,944	0.589	48.5 %
Natural Gas	0 Gallon	0	0.000	0.0 %
Fuel Oil	0 Gallon	0	0.000	0.0 %
Propane	0 Gallon	0	0.000	0.0 %
Remote Heating	0 Gallon	0	0.000	0.0 %
Remote Cooling	0 Gallon	0	0.000	0.0 %
>>> HVAC Subtotal		2,944	0.589	48.5 %
Non-HVAC Component				
Electric	49677 kWh	3,130	0.626	51.5 %
Natural Gas	0 Gallon	0	0.000	0.0 %
Fuel Oil	0 Gallon	0	0.000	0.0 %
Propane	0 Gallon	0	0.000	0.0 %
Remote Heating	0 Gallon	0	0.000	0.0 %
>>> Non-HVAC Subtotal		3,130	0.626	51.5 %
>>> GRAND TOTAL		6,074	1.216	100.0 %

* Note: 1. Cost per unit floor area is based on the gross building floor area. For this building:
  Gross floor area = 4,997 sqft
  Conditioned floor area = 4,997 sqft

ENERGY BUDGET <A>

Building : #172-Night Setback 02-28-94
Site : Fort AP Hill, Virginia 6063092204
Prepared By : E.A.C., P.C. Burke, VA
Carrier Hourly Analysis Program

TABLE 1. ANNUAL LOADS

Component	(kBTU)	(kBTU/sqft)*
Cooling Loads *	76,907	15.391
Heating Loads *	99,012	19.814

TABLE 2. ENERGY BY SYSTEM COMPONENT

	<----- Site Energy ----->		<---- Source Energy ---->	
Component	(kBTU)	(kBTU/sqft)*	(kBTU)	(kBTU/sqft)*
Air System Fans	31,511	6.306	31,511	6.306
Cooling Plants	31,370	6.278	31,370	6.278
Heating Plants	96,584	19.328	96,584	19.328
Pumps	0	0.000	0	0.000
>> HVAC Total	159,465	31.912	159,465	31.912
Lights	64,051	12.818	64,051	12.818
Other Electric	49,567	9.919	49,567	9.919
Misc. Electric	0	0.000	0	0.000
Dom. Hot Water	55,879	11.182	55,879	11.182
>> Non-HVAC Total	169,497	33.920	169,497	33.920
>> GRAND TOTAL	328,962	65.832	328,962	65.832

* Notes:
1. Site energy is the actual energy consumed.
2. Source energy accounts for electrical generating inefficiencies. For this study:
   Electric generating efficiency =100.0 %
3. Energy per unit floor area is based on the gross building floor area. For this building:
   Gross floor area = 4,997 sqft
   Conditioned floor area = 4,997 sqft
4. Annual cooling load is the sum of all cooling plant loads.
5. Annual heating load is the sum of all primary and auxiliary heating plant loads. It does not include the domestic water heating load.

ENERGY BUDGET <B>

Building : #172-Night Setback
Site : Fort AP Hill, Virginia
Prepared By : E.A.C., P.C. Burke, VA
Carrier Hourly Analysis Program

02-28-94
6063092204

TABLE 1. ANNUAL LOADS

Component	(kBTU)	(kBTU/sqft)*
Cooling Loads *	76,907	15.391
Heating Loads *	99,012	19.814

TABLE 2. ENERGY BY ENERGY COMPONENT

	<----- Site Energy ----->		<---- Source Energy ---->	
Component	(kBTU)	(kBTU/sqft)*	(kBTU)	(kBTU/sqft)*
Electric	159,465	31.912	159,465	31.912
Natural Gas	0	0.000	0	0.000
Fuel Oil	0	0.000	0	0.000
Propane	0	0.000	0	0.000
Remote Heating	0	0.000	0	0.000
Remote Cooling	0	0.000	0	0.000
>> HVAC Total	159,465	31.912	159,465	31.912
Electric	169,497	33.920	169,497	33.920
Natural Gas	0	0.000	0	0.000
Fuel Oil	0	0.000	0	0.000
Propane	0	0.000	0	0.000
Remote Heating	0	0.000	0	0.000
>> Non-HVAC Total	169,497	33.920	169,497	33.920
>> GRAND TOTAL	328,962	65.832	328,962	65.832

* Notes:
1. Site energy is the actual energy consumed.
2. Source energy accounts for electrical generating inefficiencies. For this study:
   Electric generating efficiency =100.0 %
3. Energy per unit floor area is based on the gross building floor area. For this building:
   Gross floor area = 4,997 sqft
   Conditioned floor area = 4,997 sqft
4. Annual cooling load is the sum of all cooling plant loads.
5. Annual heating load is the sum of all primary and auxiliary heating plant loads. It does not include the domestic water heating load.

ANNUAL COMPONENT COSTS
Building : 174-Night Setback
Site : Fort AP Hill, Virginia
Prepared By : E.A.C., P.C. Burke, VA
Carrier Hourly Analysis Program

02-17-94
6063092204

TABLE 1. COSTS BY COMPONENT

Component	Annual Costs * ($)	Annual Costs * ($/sqft)	% of Total
Air System Fans	258	0.054	4.6 %
Cooling Plants	509	0.106	9.1 %
Heating Plants	1,278	0.266	22.7 %
Pumps	0	0.000	0.0 %
>>> HVAC Subtotal	2,045	0.426	36.4 %
Lights	1,109	0.231	19.7 %
Other Electric	768	0.160	13.7 %
Miscellaneous Electric	0	0.000	0.0 %
Domestic Hot Water	1,698	0.354	30.2 %
>>> Non-HVAC Sub-total	3,575	0.745	63.6 %
>>> GRAND TOTAL	5,621	1.171	100.0 %

* Note: 1. Cost per unit floor area is based on the gross building floor area. For this building:
Gross floor area = 4,800 sqft
Conditioned floor area = 4,549 sqft

ANNUAL ENERGY COSTS

Building : 174-Night Setback 02-17-94
Site : Fort AP Hill, Virginia 6063092204
Prepared By : E.A.C., P.C. Burke, VA
Carrier Hourly Analysis Program

TABLE 1. COSTS BY ENERGY CATEGORY

HVAC Component	Annual Energy	<---- Annual Costs * --> ($)	($/sqft)	% of Total
Electric	32467 kWh	2,045	0.426	36.4 %
Natural Gas	0 Gallon	0	0.000	0.0 %
Fuel Oil	0 Gallon	0	0.000	0.0 %
Propane	0 Gallon	0	0.000	0.0 %
Remote Heating	0 Gallon	0	0.000	0.0 %
Remote Cooling	0 Gallon	0	0.000	0.0 %
>>> HVAC Subtotal		2,045	0.426	36.4 %
Non-HVAC Component				
Electric	56750 kWh	3,575	0.745	63.6 %
Natural Gas	0 Gallon	0	0.000	0.0 %
Fuel Oil	0 Gallon	0	0.000	0.0 %
Propane	0 Gallon	0	0.000	0.0 %
Remote Heating	0 Gallon	0	0.000	0.0 %
>>> Non-HVAC Subtotal		3,575	0.745	63.6 %
>>> GRAND TOTAL		5,621	1.171	100.0 %

* Note: 1. Cost per unit floor area is based on the gross building floor area. For this building:

Gross floor area = 4,800 sqft

Conditioned floor area = 4,549 sqft

ENERGY BUDGET <A>

Building : 174-Night Setback
Site : Fort AP Hill, Virginia
Prepared By : E.A.C., P.C. Burke, VA
Carrier Hourly Analysis Program

TABLE 1. ANNUAL LOADS

Component	(kBTU)	(kBTU/sqft)*
Cooling Loads *	70,035	14.591
Heating Loads *	74,485	15.518

TABLE 2. ENERGY BY SYSTEM COMPONENT

Component	Site Energy (kBTU)	Site Energy (kBTU/sqft)*	Source Energy (kBTU)	Source Energy (kBTU/sqft)*
Air System Fans	13,990	2.915	14,276	2.974
Cooling Plants	27,551	5.740	28,113	5.857
Heating Plants	69,236	14.424	70,649	14.719
Pumps	0	0.000	0	0.000
>> HVAC Total	110,778	23.079	113,038	23.550
Lights	60,081	12.517	61,307	12.772
Other Electric	41,588	8.664	42,437	8.841
Misc. Electric	0	0.000	0	0.000
Dom. Hot Water	91,962	19.159	93,839	19.550
>> Non-HVAC Total	193,631	40.340	197,583	41.163
>> GRAND TOTAL	304,409	63.419	310,622	64.713

* Notes:
1. Site energy is the actual energy consumed.
2. Source energy accounts for electrical generating inefficiencies. For this study:
   Electric generating efficiency = 98.0 %
3. Energy per unit floor area is based on the gross building floor area. For this building:
   Gross floor area = 4,800 sqft
   Conditioned floor area = 4,549 sqft
4. Annual cooling load is the sum of all cooling plant loads.
5. Annual heating load is the sum of all primary and auxiliary heating plant loads. It does not include the domestic water heating load.

4

ANNUAL COMPONENT COSTS

Building : 1253RangCon-Nite Setback 02-16-94

Site : FORT A.P. HILL, Virginia 6063092204

Prepared By : E.A.C., P.C. Burke, VA

Carrier Hourly Analysis Program

TABLE 1. COSTS BY COMPONENT

Component	Annual Costs * ($)	Annual Costs * ($/sqft)	% of Total
Air System Fans	317	0.063	6.8 %
Cooling Plants	1,168	0.234	25.1 %
Heating Plants	70	0.014	1.5 %
Pumps	0	0.000	0.0 %
>>> HVAC Subtotal	1,555	0.311	33.4 %
Lights	2,098	0.420	45.1 %
Other Electric	777	0.155	16.7 %
Miscellaneous Electric	0	0.000	0.0 %
Domestic Hot Water	221	0.044	4.8 %
>>> Non-HVAC Sub-total	3,096	0.619	66.6 %
>>> GRAND TOTAL	4,651	0.930	100.0 %

* Note: 1. Cost per unit floor area is based on the gross building floor area. For this building:

Gross floor area = 5,000 sqft

Conditioned floor area = 3,660 sqft

ANNUAL ENERGY COSTS

Building : 1253RangCon-Nite Setback 02-16-94
Site : FORT A.P. HILL, Virginia 6063092204
Prepared By : E.A.C., P.C. Burke, VA
Carrier Hourly Analysis Program

TABLE 1. COSTS BY ENERGY CATEGORY

HVAC Component	Annual Energy	Annual Costs * ($)	Annual Costs * ($/sqft)	% of Total
Electric	24677 kWh	1,555	0.311	33.4 %
Natural Gas	0 Gallon	0	0.000	0.0 %
Fuel Oil	0 Gallon	0	0.000	0.0 %
Propane	0 Gallon	0	0.000	0.0 %
Remote Heating	0 Gallon	0	0.000	0.0 %
Remote Cooling	0 Gallon	0	0.000	0.0 %
>>> HVAC Subtotal		1,555	0.311	33.4 %
Non-HVAC Component				
Electric	49145 kWh	3,096	0.619	66.6 %
Natural Gas	0 Gallon	0	0.000	0.0 %
Fuel Oil	0 Gallon	0	0.000	0.0 %
Propane	0 Gallon	0	0.000	0.0 %
Remote Heating	0 Gallon	0	0.000	0.0 %
>>> Non-HVAC Subtotal		3,096	0.619	66.6 %
>>> GRAND TOTAL		4,651	0.930	100.0 %

* Note: 1. Cost per unit floor area is based on the gross building floor area. For this building:
  - Gross floor area = 5,000 sqft
  - Conditioned floor area = 3,660 sqft

4

ENERGY BUDGET <A>

Building : 1253RangCon-Nite Setback 02-16-94
Site : FORT A.P. HILL, Virginia 6063092204
Prepared By : E.A.C., P.C. Burke, VA
Carrier Hourly Analysis Program Page 1 of 1

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TABLE 1. ANNUAL LOADS

Component	(kBTU)	(kBTU/sqft)*
Cooling Loads *	146,803	29.361
Heating Loads *	3,912	0.782

****

TABLE 2. ENERGY BY SYSTEM COMPONENT

Component	<----- Site Energy -----> (kBTU)	(kBTU/sqft)*	<---- Source Energy ----> (kBTU)	(kBTU/sqft)*
Air System Fans	17,167	3.433	18,071	3.614
Cooling Plants	63,260	12.652	66,590	13.318
Heating Plants	3,770	0.754	3,968	0.794
Pumps	0	0.000	0	0.000
>> HVAC Total	84,197	16.839	88,629	17.726
Lights	113,618	22.724	119,597	23.919
Other Electric	42,081	8.416	44,295	8.859
Misc. Electric	0	0.000	0	0.000
Dom. Hot Water	11,985	2.397	12,616	2.523
>> Non-HVAC Total	167,684	33.537	176,509	35.302
>> GRAND TOTAL	251,881	50.376	265,138	53.028

* Notes:
1. Site energy is the actual energy consumed.
2. Source energy accounts for electrical generating inefficiencies. For this study:
   Electric generating efficiency = 95.0 %
3. Energy per unit floor area is based on the gross building floor area. For this building:
   Gross floor area = 5,000 sqft
   Conditioned floor area = 3,660 sqft
4. Annual cooling load is the sum of all cooling plant loads.
5. Annual heating load is the sum of all primary and auxiliary heating plant loads. It does not include the domestic water heating load.

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Photocell Controls for Lighting

LIFE CYCLE COST ANALYSIS SUMMARY
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)

LOCATION: Fort A.P. Hill, Virginia REGION: 3 PROJECT NO.: DACA 31-89-C-0198
PROJECT TITLE: Fort A.P. Hill- Energy Engineering Analysis Program FISCAL YEAR: 1994
DISCRETE PORTION NAME: Photocell and Time Clock Lighting Controls
ANALYSIS DATE: January 1994 ECONOMIC LIFE (YRS) 15 PREPARER: JJS

1. INVESTMENT COSTS:

A. CONSTRUCTION COST	$	679	
B. SIOH	$	37	
C. DESIGN COST	$	41	
D. TOTAL COST (1A+1B+1C)	$	757	
E. SALVAGE VALUE OF EXISTING EQUIPMENT			
F. PUBLIC UTILITY COMPANY REBATE			
G. TOTAL INVESTMENT (1D-1E-1F)			$757

2. ENERGY SAVINGS (+)/COST(-):

DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS- Oct 1992

ENERGY SOURCE	COST $/MBTU(1)	SAVING(S) MBTU/YR(2)	ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELEC	$20.67	21.1	$ 436	11.77	$ 5,133
B. DIST	$5.69		$		$
C. RESID			$		$
D. NG			$		$
E. LPG	$7.76		$		$
F. COAL			$		$
G. SOLAR			$		$
H. GEOTH			$		$
I. BIOMA			$		$
J. REFUS			$		$
K. WIND			$		$
L. OTHER			$		$
M. DEMAND SAVINGS			$		$
N. TOTAL		21	$ 436		$ 5,133

3. NON ENERGY SAVINGS (+) OR COST (-):

A. ANNUAL RECURRING (+/-)
(1) DISCOUNT FACTOR (TABLE A)
(2) DISCOUNTED SAVINGS/COST (3A X 3A1)

B. NON RECURRING SAVINGS (+) OR COST (-)

ITEM	SAVINGS(+) COST(-)(1)	YEAR OF OCCUR. (2)	DISCOUNT FACTOR(3)	DISCOUNTED SAV-INGS(+)COST(-)(4)
a.	$			$
b.	$			$
c.	$			$
d. TOTAL				$

C. TOTAL NON ENERGY DISCOUNTED SAVINGS (3A2+3Bd4)

4. SIMPLE PAYBACK 1G/(2N3+3A+(3Bd1/ECONOMIC LIFE)):	1.74 YEARS
5. TOTAL NET DISCOUNTED SAVINGS (2N5+3C):	$5,133
6. SAVINGS TO INVESTMENT RATION (SIR) 5/1G:	6.78
7. ADJUSTED INTERNAL RATE OF RETURN (AIRR):	14.15%

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CONSTRUCTION COST ESTIMATE	Date Prepared: 1/27/94	
Activity and Location: Energy Savings Opportunity Survey Fort A. P. Hill, Virginia	Constr. Contact No. DACA 31-89-C-0198	I.D. No.
	Estimated By: EAC, P.C.	Category Code
Project: Photo Cell and Time Clock	Status: Final	Job Order No.

ITEM DESCRIPTION	QUANTITY		PRIME CONTRACTOR				SUBCONTRACTOR				TOTAL COST
			MATERIAL COST		LABOR COST		MATERIAL COST		LABOR COST		
SUMMARY	NUMBER	UNIT	UNIT COST	TOTAL	UNIT COST	TOTAL	UNIT COST	TOTAL	UNIT COST	TOTAL	
Subtotal				135		370					
DIRECT COSTS				135		370					
SUBTOTAL (DIRECT COSTS)				135		370	10.0%				
Material Tax & Labor Taxes			5.0%	7	5.0%	19	5.0%		21.0%		
Overhead			15.0%	20	15.0%	56	15.0%		15.0%		
SUBTOTAL				162		444					
Profit			12.0%	19	12.0%	53	12.0%		12.0%		
SUBTOTAL				181		498					
Prime Overhead on Sub							5.0%		5.0%		
SUBTOTAL											
Prime Profit on Sub							5.0%		5.0%		
TOTAL COST				181		498					$679

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CONSTRUCTION COST ESTIMATE	Date Prepared: 1/27/94	Reference: MMM Design 1982/RS Means 1992
Activity and Location: Energy Savings Opportunity Survey Fort A. P. Hill, Virginia	Constr. Contact No. DACA 31-89-C-0198	I.D. No.
	Estimated By: EAC, P.C.	Category Code
Project: Photo Cell and Time Clock	Status: Final	Job Order No.

ITEM DESCRIPTION	QUANTITY		PRIME CONTRACTOR				SUBCONTRACTOR				TOTAL COST
			MATERIAL COST		LABOR COST		MATERIAL COST		LABOR COST		
	NUMBER	UNIT	UNIT COST	TOTAL	UNIT COST	TOTAL	UNIT COST	TOTAL	UNIT COST	TOTAL	
#12 wire	15	CLF	6.00	90	19.00	285					375
Junction Box	2	E	1.50	3	10.45	21					24
3/4" Conduit	15	LF	1.00	15	2.03	30					45
Photo Cell	1	EA	12.00	12	14.00	14					26
Pitch Pockett	1	EA	15.00	15	20.00	20					35
Subtotal				$135		$370					$505

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DESIGN ANALYSIS

■ BUDGET
□ PRELIMINARY
□ FINAL
□ OTHER

PROJECT NAME: EEA FORT HILL	PROJECT PART: BLDG 179	SPEC. DIVISION: LIGHTING
DEPARTMENT: ELECT.	COMPUTED BY: CJA DATE: 3-16-82	JOB NO: 4417.01
SHEET NO: OF:	CHECKED BY: DATE:	SHEET NO: OF:

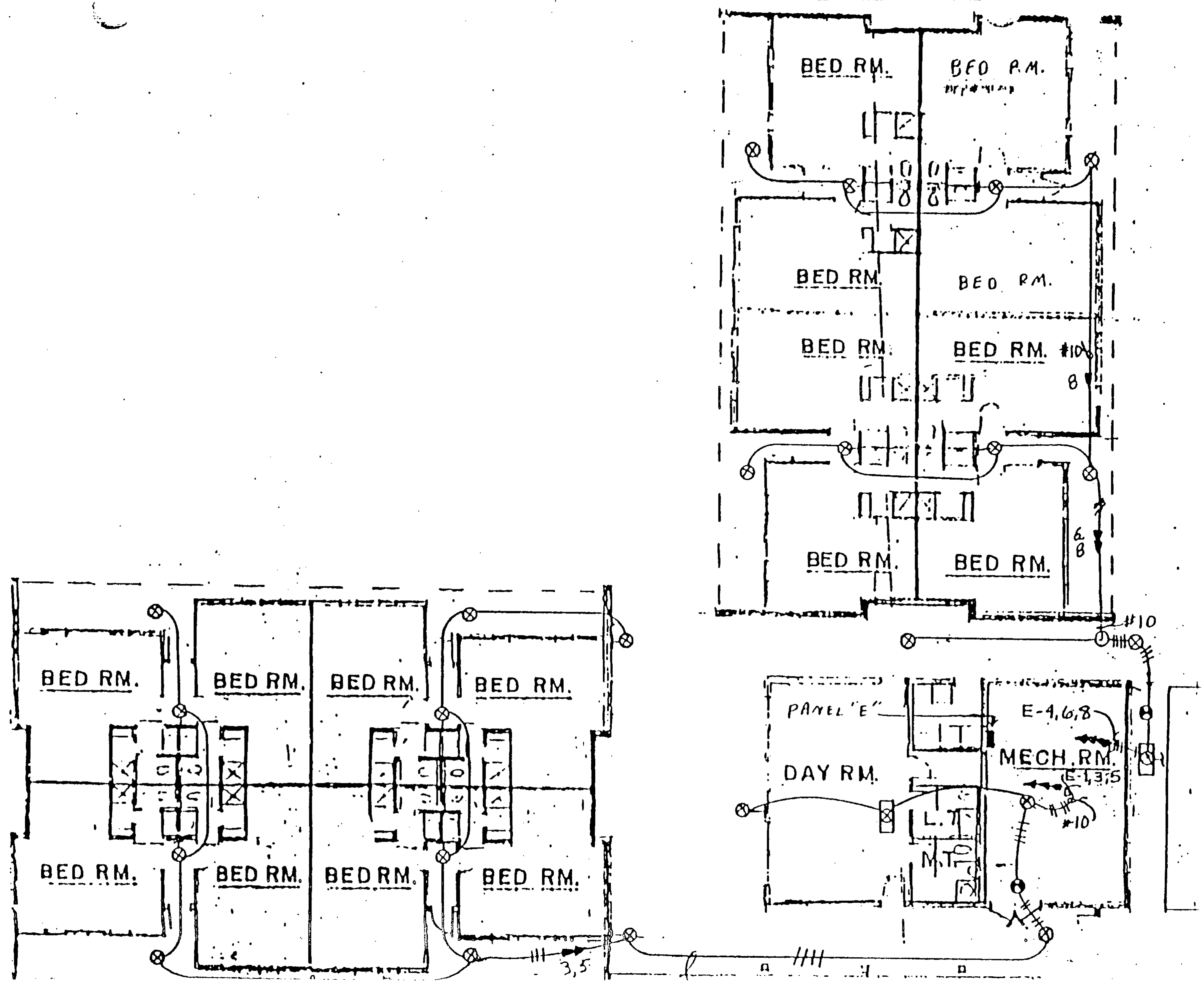
DURING OUR FIELD VISITS TO FORT HILL WE NOTICED THAT IN BUILDING 179 SOME EXTERIOR (CANOPY) LIGHTS WERE ON CONTINUOUSLY DAY AND NIGHT. ON THE PLANS THAT WERE PROVIDED TO US THESE LIGHTS ARE CALLED EMERGENCY LIGHTS. ACTUALLY THEY ARE NIGHT LIGHTS SINCE EMERGENCY POWER IS NOT PROVIDED. THEY ARE SIMPLY CONTROLLED BY CIRCUIT BREAKERS E-1, E-3, E-4, E-5, E-6, AND E-8. A FLOOR PLAN OF THE EXISTING LIGHTS IS SHOWN IN THE NEXT PAGE.

SINCE PART OF THESE LIGHTS DO NOT SERVE ANY PURPOSE BY BEING ON DURING THE DAY WE PROPOSE TO PUT THEM ON PHOTOCELL CONTROL, A FLOOR PLAN OF THE NEW (PROPOSED) LIGHTS IS FOLLOWING THE FLOOR PLAN OF THE EXISTING LIGHTS. CIRCUITS E-5 AND E-8 SHALL BE ON PHOTOCELL CONTROL AND CIRCUITS E-3 AND E-6 SHALL BE ON CONTINUOUSLY. THERE EXIST 1-100W LAMP IN EACH INCANDESCENT FIXTURE. THE PROPOSED DESIGN CALLS FOR 13 FIXTURES ON THE PHOTOCELL CONTROLLED CIRCUITS. THEREFORE WE HAVE 1300W SAVINGS FOR AN AVERAGE OF 13 HOURS PER DAY WHOLE YEAR AROUND. TOTAL ENERGY SAVINGS PER YEAR:

$$(1300\,W)\left(13\,\frac{HOURS}{DAY}\right)\left(365\,\frac{DAYS}{YEAR}\right) = 6168.5\,\frac{KWH}{YEAR}$$

$$\left(6168.5\,\frac{KWH}{YEAR}\right)\left(\cancel{11600}\ 3413\,\frac{BTU}{KWH}\right) = \cancel{71.555}\ 21.1\,\frac{MBTU}{YEAR}$$

EXISTING-EXTERIOR EMERGENCY LIGHTS BLDG. 179

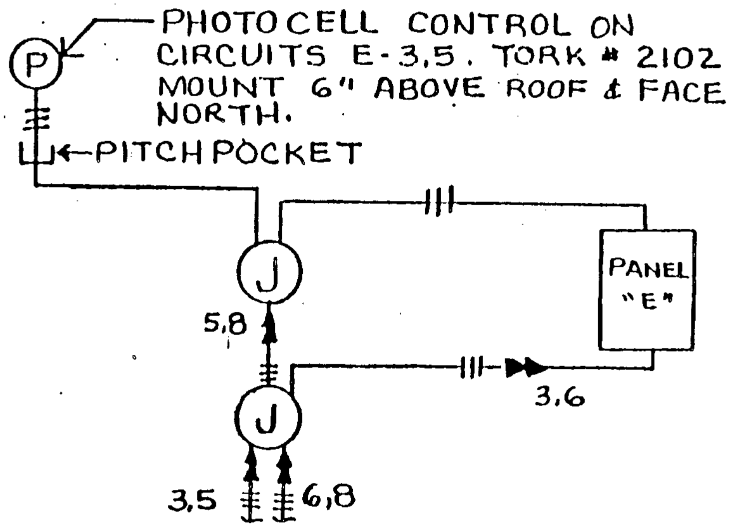


NEW- EXTERIOR EMERGENCY LIGHTS BLDG 179

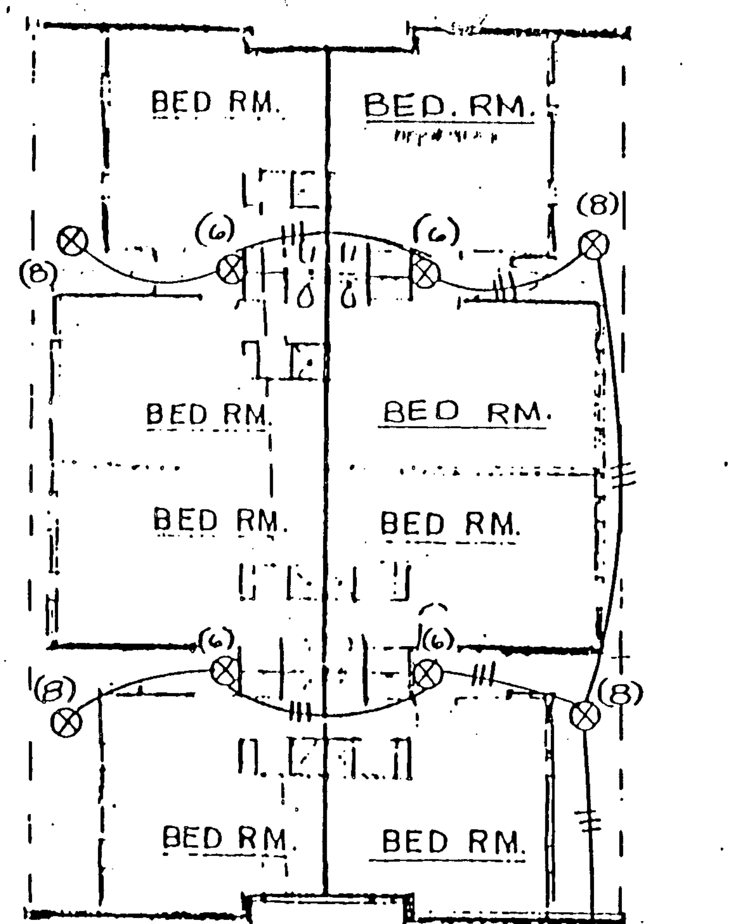
NOTES:

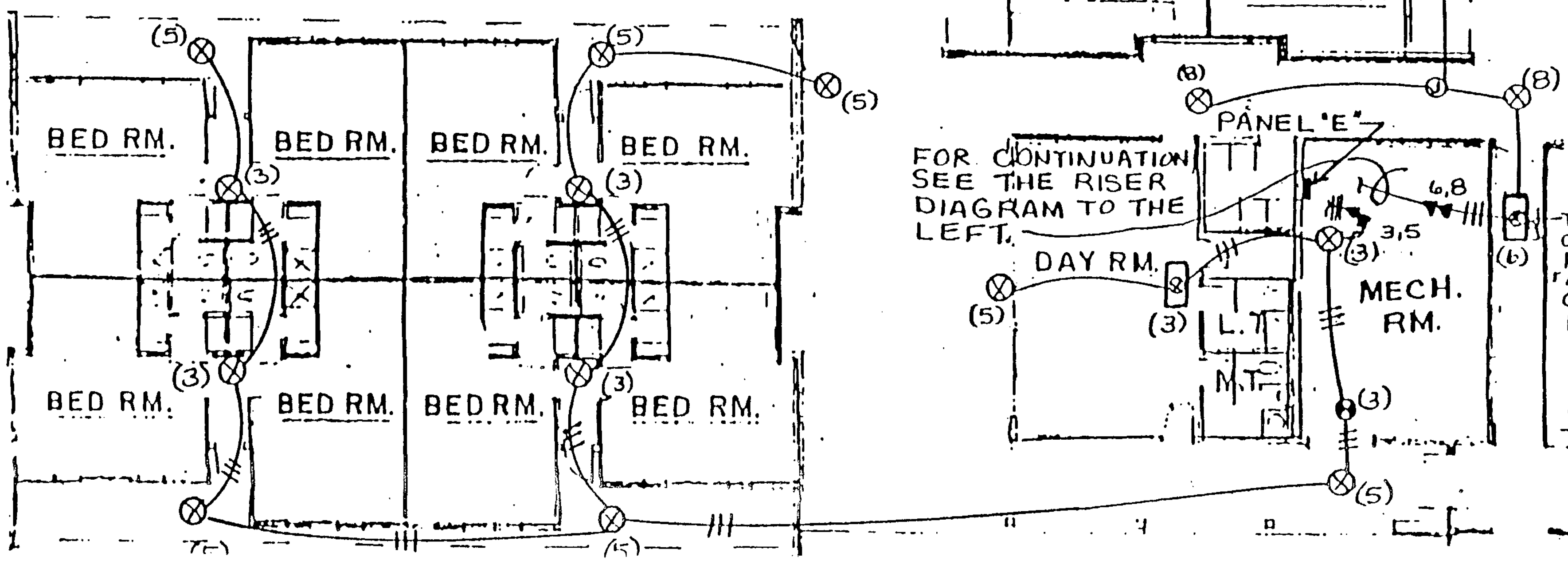
(1) AL WIRE ALL BE #12.

(2) RUN WIRE IN EXISTING CONDUIT



RISER DIAGRAM





Replacing Fluorescent Lamps with High Efficiency Types

LIFE CYCLE COST ANALYSIS SUMMARY
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)

LOCATION: Fort A.P. Hill, Virginia REGION: 3 PROJECT NO.: DACA 31-89-C-0198
PROJECT TITLE: Fort A.P. Hill- Energy Engineering Analysis Program FISCAL YEAR: 1994
DISCRETE PORTION NAME: Replacing Standard Fluorescent Lamps with High Efficiency Types
ANALYSIS DATE: January 1994 ECONOMIC LIFE (YRS) 15 PREPARER: JJS

1. INVESTMENT COSTS:

A. CONSTRUCTION COST	$	17,500	
B. SIOH	$	963	
C. DESIGN COST	$	1,050	
D. TOTAL COST (1A+1B+1C)	$	19,513	
E. SALVAGE VALUE OF EXISTING EQUIPMENT			
F. PUBLIC UTILITY COMPANY REBATE			
G. TOTAL INVESTMENT (1D-1E-1F)			$19,513

2. ENERGY SAVINGS (+)/COST(-):

DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS- Oct 1992

ENERGY SOURCE	COST $/MBTU(1)	SAVING(S) MBTU/YR(2)	ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELEC	$20.67	493.1	$ 10,192	11.77	$ 119,964
B. DIST	$5.69	(74.8)	$ (426)	13.83	$ (5,886)
C. RESID			$		$
D. NG			$		$
E. LPG	$7.76		$		$
F. COAL			$		$
G. SOLAR			$		$
H. GEOTH			$		$
I. BIOMA			$		$
J. REFUS			$		$
K. WIND			$		$
L. OTHER			$		$
M. DEMAND SAVINGS			$		$
N. TOTAL		418	$ 9,767		$ 114,078

3. NON ENERGY SAVINGS (+) OR COST (-):

A. ANNUAL RECURRING (+/-)
(1) DISCOUNT FACTOR (TABLE A)
(2) DISCOUNTED SAVINGS/COST (3A X 3A1)

B. NON RECURRING SAVINGS (+) OR COST (-)

ITEM	SAVINGS(+) COST(-)(1)	YEAR OF OCCUR. (2)	DISCOUNT FACTOR(3)	DISCOUNTED SAVINGS(+)COST(-)(4)
a.	$			$
b.	$			$
c.	$			$
d. TOTAL				$

C. TOTAL NON ENERGY DISCOUNTED SAVINGS (3A2+3Bd4)

4. SIMPLE PAYBACK 1G/(2N3+3A+(3Bd1/ECONOMIC LIFE)):	2.00 YEARS
5. TOTAL NET DISCOUNTED SAVINGS (2N5+3C):	$114,078
6. SAVINGS TO INVESTMENT RATION (SIR) 5/1G:	5.85
7. ADJUSTED INTERNAL RATE OF RETURN (AIRR):	12.99%

\project\9200\ecip\flamps

CONSTRUCTION COST ESTIMATE	Date Prepared: 1/27/94	
Activity and Location: Energy Savings Opportunity Survey Fort A. P. Hill, Virginia	Constr. Contact No. DACA 31-89-C-0198	I.D. No.
	Estimated By: EAC, P.C.	Category Code
Project: Replace Fluorescent Lamps With High Efficiency Types	Status: Final	Job Order No.

ITEM DESCRIPTION	QUANTITY		PRIME CONTRACTOR				SUBCONTRACTOR				TOTAL COST
			MATERIAL COST		LABOR COST		MATERIAL COST		LABOR COST		
SUMMARY	NUMBER	UNIT	UNIT COST	TOTAL	UNIT COST	TOTAL	UNIT COST	TOTAL	UNIT COST	TOTAL	
Subtotal				11,074		3,510					
DIRECT COSTS				11,074		3,510					
SUBTOTAL (DIRECT COSTS)				11,074		3,510					
Material Tax & Labor Taxes			5.0%	554	5.0%	176	5.0%		21.0%		
Overhead			15.0%	1,661	15.0%	527	15.0%		15.0%		
SUBTOTAL				13,288		4,212					
Profit							12.0%		12.0%		
SUBTOTAL				13,288		4,212					
Prime Overhead on Sub							5.0%		5.0%		
SUBTOTAL											
Prime Profit on Sub							5.0%		5.0%		
TOTAL COST				13,288		4,212					$17,500

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CONSTRUCTION COST ESTIMATE	Date Prepared: 1/27/94	Reference: MMM Design 1982/RS Means
Activity and Location: Energy Savings Opportunity Survey Fort A. P. Hill, Virginia	Constr. Contact No. DACA 31-89-C-0198	I.D. No.
	Estimated By: EAC, P.C.	Category Code
Project: Replace Fluorescent Lamps With High Efficiency Types	Status: Final	Job Order No.

ITEM DESCRIPTION	QUANTITY		PRIME CONTRACTOR				SUBCONTRACTOR				TOTAL COST
			MATERIAL COST		LABOR COST		MATERIAL COST		LABOR COST		
	NUMBER	UNIT	UNIT COST	TOTAL	UNIT COST	TOTAL	UNIT COST	TOTAL	UNIT COST	TOTAL	
F30 T12 WMII	36	EA	3.45	124	1.50	54					178
F40 T12 WMII	1,044	EA	3.85	4,019	1.50	1,566					5,585
F96 T12 WMII	1,260	EA	5.50	6,930	1.50	1,890					8,820
SUBTOTAL				$11,074		$3,510					$14,584

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BUILDING GROUP ENERGY SAVINGS

FORT HILL - REPLACING FLUORESCENT LAMPS WITH HIGH EFFICIENCY TYPES

BUILDING GROUP	SAMPLE BUILDING	TOTAL GROUP SQ.-FT.	** SAMPLE BUILDING GROUP AVERAGE BTU/FT^2-YR.			TOTAL BUILDING GROUP AVERAGE BTU -YR. X 10^6		
			ELECTRIC	FUEL	TOTAL	ELECTRIC	FUEL	TOTAL
A-1	101, 126, 214	122962	3142	-421	2721	386.35	-51.77	334.58
A-1 WINTERIZED	101, 126, 214	11,499	1932	-19	1913	22.2	-.20	22.00
A-2	*	8748	1932	-19	1913	16.9	-.17	16.73
B-1	-	-	-	-	-	-	-	-
B-2	1528	38,967	330	-78	252	12.86	-3.04	9.82
C-1	-	-	-	-	-	-	-	-
C-2	-	-	-	-	-	-	-	-
D-1	179.D'	6275	2968	-714	2254	18.62	-4.48	14.14
D-1 WINTERIZED	-	-	-	-	-	-	-	-
D-2	820	18,176	1991	-831	1160	36.20	-15.10	21.10
E-1	821	-	-	-	-	-	-	-
BASE 53	TOTALS -					493.13	-74.76	418.37

FORT HILL - - REPLACING STANDARD FLUORESCENT LAMPS WITH HIGH EFFIC.

BUILDING GROUP	SAMPLE BUILDING	SAMPLE BUILDING SQ.-FT.	TOTAL GROUP SQ.-FT	EXISTING NUMBER OF LAMPS PER SAMPLE BUILDING				PROPOSED NUMBER OF LAMPS PER TOTAL GROUP		
				F30T12	F40T12	F96T12		F30T12	F40T12	[illegible]
A-1	101, 126, 214	18,761	122962		72	1[illegible]			472	1081
A-1 WINTERIZED	101, 126, 214	18,761	11,499		72	1[illegible]			45	102
A-2	*	18,761	8748		72	165			34	77
B-2	1528	7,563	38,967		16				83	
C-1	—	—	—	—	—	—		—	—	—
C-2	—	—	—	—	—	—		—	—	—
D-1	179	6275	6275	36	198			36	198	
D-2	820	6,176	18,176		72				212	
BASE	TOTALS -							36	1044	1260

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DESIGN ANALYSIS

■ BUDGET
□ PRELIMINARY
□ FINAL
□ OTHER

PROJECT NAME: EEA	PROJECT PART: FORT HILL	SPEC. DIVISION: REPLACING FLUORESCENT LAMPS
DEPARTMENT: ELECTRICAL	COMPUTED BY: CJH DATE: 5-7-82	JOB NO: 4217.02
SHEET NO: OF:	CHECKED BY: DATE:	SHEET NO: OF:

CALCULATION OF LAMP ECONOMIC LIFE BASED ON WEIGHTED AVERAGES OF EACH OF 3 LAMP TYPES.

	TOTAL LAMPS	% OF TOTAL	LAMP LIFE	
F30T12	36	.01177	18 000 HRS	= 212 HRS
F40T12	1968	.6435	20 000 HRS	= 12871 HRS
F96T12	1054	.3447	12 000 HRS	= 4136 HRS
TOTAL	3058			17219 HOURS

$$\frac{\text{AVERAGE OPERATIONAL HOURS}}{\text{YEAR}} = \left(10\ \frac{\text{HOURS}}{\text{DAY}}\right)\left(5\ \frac{\text{DAYS}}{\text{WEEK}}\right)\left(52\ \frac{\text{WEEKS}}{\text{YEAR}}\right) = 2600\ \text{H/Y}$$

$$\frac{17219\ \text{H}}{2600\ \text{H/Y}} = 6.62\ \text{YEARS}$$

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NORFOLK, VIRGINIA ▪ WASHINGTON, D.C. ▪ ATHENS, GREECE ▪ HOUSTON, TEXAS ▪ FRANKFURT, GER...

ANALYSIS

☐ PRELIMINARY
☐ FINAL
☐ OTHER

PROJECT NAME: EEA	PROJECT PART: A.P. HILL	SPEC. DIVISION: LIGHTING
DEPARTMENT: ELECTRICAL	COMPUTED BY: C.J.A DATE: 1/17/82	JOB NO: 4417.02
SHEET NO: OF:	CHECKED BY: DATE:	SHEET NO: OF:

TYPE OF LAMPS	EXISTING (STANDARD) AVERAGED RATED LIFE (hours)	EXISTING (STANDARD) LAMP LUMENS	NEW (ENERGY SAVER) AVERAGED RATED LIFE (hours)	NEW (ENERGY SAVER) LAMP LUMENS	% LAMP LUMENS (N / LAMP LUMENS (S
F40T12CW	20000	3150	20000	3050	.968
F96T12 SL	12000	6300	12000	6000	.952
F96T12 HO	12000	9200	12000	9100	.989
F30T12	18000	2300	1800	2050	.891

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DESIGN ANALYSIS

- [x] BUDGET
- [ ] PRELIMINARY
- [ ] FINAL
- [ ] OTHER

PROJECT NAME: EEA	PROJECT PART: FORT HILL	SPEC. DIVISION: REPLACE FLUORESCENT LAMPS
DEPARTMENT: ELECTRICAL	COMPUTED BY: DGW DATE: 11-20-82	JOB NO: 4437.02
SHEET NO: OF:	CHECKED BY: DATE:	SHEET NO: OF:

APPLICABLE BUILDINGS

NON-WINTERIZED						WINTERIZED		ADDITIONAL NON-WINTERIZED
A-1						A-1		A-1
101	1227	326	361	1290	1296	121	506	113
103	1231	327	362	1219	1323	122	530	136
104	304	328	363	1301	1324	123	707	145
105	A-2	329	712	1401	1423	224	708	163
109	178	330	713	1501	1424	1201	804	201
115	226	331	715	1601	1425	1535	1320	214
116	512	332	364	1326	1474	A-2	1320	217
124	714	333	B-2	1327	1523	1630	1521	
126	807	334	253	1545	1524	1632	1522	242 TOTAL Bldgs
127	1304	335	1526	1546	1538	1633		
128	1404	336	1528	C-3	1623	1634		
129	1504	337	1529	108	1624	1650		
134	1604	338	1532	182	2002	1654		
135	B-1	339	1533	206	D-1	1656		
137	125	340	C-1	222	143	1664		
139	130	341	102	257	179B	1672		
140	131	342	106A	515	303	1673		
144	132	343	313	711	811	1677		
120	133	344	808	730	812	1679		
158	179A	345	1214	985	813	1683		
250	209	346	1224	986	814	1684		
251	211	347	1226	989	D-2	1685		
312	292	348	1282	1207	820	1687		
815	293	349	C-2	1208	1525	B-1		
816	294	350	148	1210	D-3	801		
817	[illegible]	351	149	1211	1204	1205		
818	309	352	151	1213B	175	C-1		
1220	310	353	219	1215	E-1	142		
1221	311	354	220	1216	305	708		
1225	320	355	258	1217	306	D-3		
1262	321	356	501	1226	821	1641		
1527	322	357	705	1230		1659		
2001	323	358	803	1268B		1690		
9071	324	359	1213	1293		E-1		
1206	325	360	1222	106B		227		

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Occupancy Sensors

LIFE CYCLE COST ANALYSIS SUMMARY
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)

LOCATION: Fort A.P. Hill, Virginia REGION: 3 PROJECT NO.: DACA 31-89-C-0198
PROJECT TITLE: Fort A.P. Hill- Energy Engineering Analysis Program FISCAL YEAR: 1994
DISCRETE PORTION NAME: Occupancy Sensors
ANALYSIS DATE: January 1994 ECONOMIC LIFE (YRS 15 PREPARER: JJS

1. INVESTMENT COSTS:

A. CONSTRUCTION COST	$	29,681	
B. SIOH	$	1,632	
C. DESIGN COST	$	1,781	
D. TOTAL COST (1A+1B+1C)	$	33,094	
E. SALVAGE VALUE OF EXISTING EQUIPMENT			
F. PUBLIC UTILITY COMPANY REBATE			
G. TOTAL INVESTMENT (1D-1E-1F)			$33,094

2. ENERGY SAVINGS (+)/COST(-):

DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS- Oct 1992

ENERGY SOURCE	COST $/MBTU(1)	SAVING(S) MBTU/YR(2)	ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELEC	$20.67	795.0	$ 16,433	11.77	$ 193,412
B. DIST	$5.69		$		$
C. RESID			$		$
D. NG			$		$
E. LPG	$7.76		$		$
F. COAL			$		$
G. SOLAR			$		$
H. GEOTH			$		$
I. BIOMA			$		$
J. REFUS			$		$
K. WIND			$		$
L. OTHER			$		$
M. DEMAND SAVINGS			$		$
N. TOTAL		795	$ 16,433		$ 193,412

3. NON ENERGY SAVINGS (+) OR COST (-):

A. ANNUAL RECURRING (+/-)
(1) DISCOUNT FACTOR (TABLE A)
(2) DISCOUNTED SAVINGS/COST (3A X 3A1)

B. NON RECURRING SAVINGS (+) OR COST (-)

ITEM	SAVINGS(+) COST(-)(1)	YEAR OF OCCUR. (2)	DISCOUNT FACTOR(3)	DISCOUNTED SAV-INGS(+)COST(-)(4)
a.	$			$
b.	$			$
c.	$			$
d. TOTAL				$

C. TOTAL NON ENERGY DISCOUNTED SAVINGS (3A2+3Bd4)

4. SIMPLE PAYBACK 1G/(2N3+3A+(3Bd1/ECONOMIC LIFE)):	2.01 YEARS
5. TOTAL NET DISCOUNTED SAVINGS (2N5+3C):	$193,412
6. SAVINGS TO INVESTMENT RATION (SIR) 5/1G:	5.84
7. ADJUSTED INTERNAL RATE OF RETURN (AIRR):	12.99%

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CONSTRUCTION COST ESTIMATE	PREPARED: March 1994	SHEET 1 OF 2
PROJECT: Energy Savings Oppurtunity Survey	CONTRACT NO.: DACA 31-89-C-0198	
LOCATION: Fort A.P. Hill, Virginia		
AE PROJECT NO.: 92008	ESTIMATOR: JS	PRELIM:
AE: Engineering Applications Consultants, P.C.	CHECKED BY: VP	FINAL: X

SUMMARY: Occupancy Sensors

ITEM	QUANTITY		MATERIAL		LABOR		TOTAL
	NO.	MEAS	UNIT	COST	UNIT	COST	COST
Occupancy Sensors- Infrared Wall Switch							
SUBGROUP							
Administration Buildings	26	EA	77.00	2,002	7.00	182	2,184
Dinning Facilities	15	EA	77.00	1,155	7.00	105	1,260
Housing Facilities	157	EA	77.00	12,089	7.00	1,099	13,188
Field Latrines	60	EA	77.00	4,620	7.00	420	5,040
SUB-TOTAL				19,866		1,806	21,672

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CONSTRUCTION COST ESTIMATE

PROJECT: Energy Savings Oppurtunity Survey	PREPARED: March 1994 SHEET OF
	SHEET 2 OF 2
	CONTRACT NO.: DACA 31-89-C-0198
LOCATION: Fort A.P. Hill, Virginia	
AE PROJECT NO.:	ESTIMATOR: JS PRELIM:
AE: Engineering Applications Consultants, P.C.	CHECKED BY: VP FINAL: X

SUMMARY: Occupancy Sensors

ITEM	QUANTITY		MATERIAL		LABOR		TOTAL
	NO.	MEAS	UNIT	COST	UNIT	COST	COST
SUBTOTAL PREV. PAGE				19,866		1,806	21,672
MARK-UP ON LABOR	21.0%			—		379	379
SUB-TOTAL							22,051
TAXES ON MATERIAL	5.0%			993		—	993
SUB-TOTAL							23,045
OVERHEAD	15.0%						3,457
SUB-TOTAL							26,501
PROFIT	12.0%						3,180
SUB-TOTAL							29,681
PRIME MARK-UP ON SUB							
SUB-TOTAL							29,681
GRAND TOTAL							29,700

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ECO	ECO Savings		Average Study Blg Savings		Average Study Blg Cost		Average Group Savings		Average Group Cost		No. of Units Per Study Bldg	Units per Study Blg Floor Area	Total Units Per Group
Subgroup B-1- Study Blg 174	MBtu/Yr	$/Yr	MBtu/ft**2	$/Yr/ft**2	Materials $/ft**2	Labor $/ft**2	MBtu/Yr	$/Yr	Materials $	Labor $			
Low Flow Shower Heads	37.2	769	0.0078	0.1602	150	42	417.1	8,622	1,682	471	6	0.00125	67
Compact Fluorescent Lighting	41.9	774	0.0087	0.1613	322	7	469.8	8,678	3,610	78	14	0.002917	157
Occupancy Sensors	55.4	1021	0.0115	0.2127	1078	98	621.2	11,448	12,087	1,099	14	0.002917	157
Water Heater Timer	1.13	23	0.0002	0.0048	40	18	12.7	258	449	202	1	0.000208	11
Energy Savings Fluorescent Lamps	19.6	361	0.0041	0.0752	490	213	219.8	4,048	5,494	2,388	142	0.029583	1,592
F32 T-8 Lighting System	12	221	0.0025	0.0460	2804	726	134.6	2,478	32,561	8,140	33	0.006875	370
Water Heater Insulation	1.17	24	0.0002	0.0050	25	18	13.1	269	280	202	1	0.000208	18

ECO	ECO Savings		Average Study Blg Savings		Average Study Blg Cost		Average Group Savings		Average Group Cost		No. of Units Per Study Bldg	Units per Study Blg Floor Area	Total Units Per Group
Subgroup D-1- Study Blg 172	MBtu/Yr	$/Yr	MBtu/ft**2	$/Yr/ft**2	Materials $	Labor $	MBtu/Yr	$/Yr	Materials $	Labor $			
Compact Fluorescent Lights	4.12	76	0.0010	0.0178	142	3	4.1	76	142.00	3.00	6	0.001404	6
Energy Savings Fluorescent Lamps	3.68	68	0.0009	0.0159	131	57	3.7	68	131.00	57.00	38	0.008895	38
Occupancy Sensors	15.46	285	0.0036	0.0667	1213	284	15.5	285	1,213.00	284.00	15	0.003511	15
Exit Sign Retrofit	14.08	260	0.0033	0.0609	1375	275	14.1	260	1,375.00	275.00	11	0.002575	11
Water Heater Timers	0.5	9	0.0001	0.0021	40	18	0.5	9	40.00	18.00	1	0.000234	1
DayLight Dimming Controls	0.56	10	0.0001	0.0023	180	100	0.6	10	180.00	100.00	1	0.000234	1

ECO	ECO Savings		Average Study Blg Savings		Average Study Blg Cost		Average Group Savings		Average Group Cost		No. of Units Per Study Bldg	Units per Study Blg Floor Area	Total Units Per Group
Subgroup E-2 Latrines	MBtu/Yr	$/Yr	MBtu/ft**2	$/Yr/ft**2	Materials $	Labor $	MBtu/Yr	$/Yr	Materials $	Labor $			
Compact Flourescent Lights	6.38	117	0.0446	0.8182	23	2	175.4	3,216	632.26	54.98	4	0.027972	119
Occupancy Sensors	2.12	40	0.0148	0.2797	154	14	58.3	1,100	4,233.38	384.85	2	0.013986	60

	Dinning	Housing	Admin	Field Latrines
Building Number	172	174	1,253	412
Floor Area (Ft**2)	4,272	4,800	5,000	143
Group Floor Area (Ft**2)	4,272	53,820	11,800	3,931

Existing Energy Usage- Bldg 1253	
MBtu/Yr	280.7
$/Yr	5,183
Existing Energy Usage- Bldg 174	
MBtu/Yr	378.7
$/Yr	6,992
Existing Energy Usage- Bldg 172	
MBtu/Yr	438.1
$/Yr	8,088

ECO	ECO Savings		Average Study Blg Savings		Average Study Blg Cost		Average Group Savings		Average Group Cost		No. of Units Per Study Bldg	Units per Study Blg Floor Area	Total Units Per Group
Subgroup A-1- Study Blg 1253	MBtu/Yr	$/Yr	MBtu/ft**2	$/Yr/ft**2	Materials $	Labor $	MBtu/Yr	$/Yr	Materials $	Labor $			
Low Flow Shower Heads	11.2	231	0.0031	0.0631	25	7	36.1	745	81	23	1	0.000273	3
Occupancy Sensors	31	573	0.0085	0.1566	616	56	99.9	1,847	1,986	181	8	0.002186	26
Compact Fluorescent Lights	6.93	127	0.0019	0.0347	192	4	22.3	409	619	13	8	0.002186	26
Energy Saving Fluorescent Lamps	22.8	420	0.0062	0.1148	497	216	73.5	1,354	1,602	696	144	0.039344	464
Exit Signs	5.38	150	0.0015	0.0410	500	100	17.3	484	1,612	322	4	0.001093	13
F32 T-8 Lighting System	39.7	733	0.0108	0.2003	2317	607	128.0	2,363	7,470	1,957	53	0.014481	171
Economizer Controls	24	444	0.0066	0.1213	2258	1280	77.4	1,431	7,280	4,127	1	0.000273	3
Daylight Dimming Controls	6.2	113	0.0017	0.0309	720	400	20.0	364	2,321	1,290	4	0.001093	13
Water Heater Timers	0.112	3	0.0000	0.0008	40	18	0.4	10	129	58	1	0.000273	3
Water Heater Insulation	1.17	24	0.0003	0.0066	25	18	3.8	77	81	58	1	0.000273	3

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New Buildings List- Buildings built after 1985 Fort A.P. Hill

SUBGROUP A-1

Bldg. No	Description		Floor Area (Ft**2)
1247	Entomology Facility		1,800
1252	General Inst. Bldg		5,000
1253	Range Control Bldg		5,000
		TOTAL	11,800

SUBGROUP B-1

Bldg. No	Description		Floor Area (Ft**2)
174	Guest House		4,800
290	Log Cabin Bullocks Lake		1,056
1350	FH NCO & ENL, QTRS 8		7,256
1351	FH NCO & ENL, QTRS 6		7,256
1352	FH NCO & ENL, QTRS 4		7,256
1353	FH NCO & ENL, QTRS 2		3,804
1354	FH Colonel, QTRS 1		2,553
1355	CO Grade & WO, QTRS 3		4,846
1356	FH NCO & ENL, QTRS 5		7,737
1357	FH NCO & ENL, QTRS 7		7,256
		TOTAL	53,820

SUBGROUP D-1

Bldg. No	Description		Floor Area (Ft**2)
172	Open Dinning NCO		4,272
		TOTAL	4,272

SUBGROUP E-1

Bldg. No	Description		Floor Area (Ft**2)
1241	Detached Latrine/Shwr		533

SUBGROUP E-2

Bldg. No	Description		Floor Area (Ft**2)
412	Detached Latrine TA12		143
413	Detached Latrine TA12		143
529	Detached Latrine Area 15		90
531	Detached Latrine TA15		143
733	Detached Latrine TNG 18		90
745	Detached Latrine TNG 14		144
746	Detached Latrine Rapp. Compound		144
748	Detached Latrine TA 18		143
826	Detached Latrine Range 42		143
828	Detached Latrine TNG 28		144
839	Detached Latrine at Repell. Twr		143
924	Detached Latrine		108
928	Detached Latrine		144
1008	Detached Latrine- Range 25		143
1024	Detached Latrine-Range 24		144
1108	Detached Latrine-Range 28P		144
1109	Detached Latrine-Range 28P		144
1110	Detached Latrine-Range 28P		144
1114	Detached Latrine		144
1116	Detached Latrine-Range 33		143
1202	Detached Latrine- Range 7		143
1254	Detached Latrine-Range 37		143
1256	Detached Latrine		108
1263	Detached Latrine-Range 6		143
1403	Detached Latrine-Tr Area 5		90
1405	Detached Latrine-Tr Area 3		90
1428	Detached Latrine-Tr Area 3		144
1619	Detached Latrine-Tr Area 21		90
1670	Detached Latrine-Tr Area 21		144
S 1272	Detached Latrine- Range 33		108
		TOTAL	3,931

Energy Savings Fluorescent Lamps

LIFE CYCLE COST ANALYSIS SUMMARY
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)

LOCATION: Fort A.P. Hill, Virginia   REGION: 3   PROJECT NO.: DACA 31-89-C-0198
PROJECT TITLE: Fort A.P. Hill- Energy Engineering Analysis Program   FISCAL YEAR: 1994
DISCRETE PORTION NAME: Energy Saving Fluorescent Lamps
ANALYSIS DATE: January 1994   ECONOMIC LIFE (YRS 15   PREPARER: JJS

1. INVESTMENT COSTS:

A. CONSTRUCTION COST	$	14,665	
B. SIOH	$	807	
C. DESIGN COST	$	880	
D. TOTAL COST (1A+1B+1C)	$	16,351	
E. SALVAGE VALUE OF EXISTING EQUIPMENT			
F. PUBLIC UTILITY COMPANY REBATE			
G. TOTAL INVESTMENT (1D-1E-1F)			$16,351

2. ENERGY SAVINGS (+)/COST(-):

DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS- Oct 1992

ENERGY SOURCE	COST $/MBTU(1)	SAVING(S) MBTU/YR(2)	ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELEC	$20.67	297.0	$ 6,139	11.77	$ 72,256
B. DIST	$5.69		$		$
C. RESID			$		$
D. NG			$		$
E. LPG	$7.76		$		$
F. COAL			$		$
G. SOLAR			$		$
H. GEOTH			$		$
I. BIOMA			$		$
J. REFUS			$		$
K. WIND			$		$
L. OTHER			$		$
M. DEMAND SAVINGS			$		$
N. TOTAL		297	$ 6,139		$ 72,256

3. NON ENERGY SAVINGS (+) OR COST (-):

A. ANNUAL RECURRING (+/-)
(1) DISCOUNT FACTOR (TABLE A)
(2) DISCOUNTED SAVINGS/COST (3A X 3A1)

B. NON RECURRING SAVINGS (+) OR COST (-)

ITEM	SAVINGS(+) COST(-)(1)	YEAR OF OCCUR. (2)	DISCOUNT FACTOR(3)	DISCOUNTED SAVINGS(+)COST(-)(4)
a.	$			$
b.	$			$
c.	$			$
d. TOTAL				$

C. TOTAL NON ENERGY DISCOUNTED SAVINGS (3A2+3Bd4)

4. SIMPLE PAYBACK 1G/(2N3+3A+(3Bd1/ECONOMIC LIFE)):	2.66 YEARS
5. TOTAL NET DISCOUNTED SAVINGS (2N5+3C):	$72,256
6. SAVINGS TO INVESTMENT RATION (SIR) 5/1G:	4.42
7. ADJUSTED INTERNAL RATE OF RETURN (AIRR):	10.83%

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CONSTRUCTION COST ESTIMATE

PREPARED: March 1994

PROJECT: Energy Savings Oppurtunity Survey

CONTRACT NO.: DACA 31-89-C-0198

LOCATION: Fort A.P. Hill, Virginia
AE PROJECT NO.: 92008
AE: Engineering Applications Consultants, P.C.

ESTIMATOR: JS
CHECKED BY: VP

PRELIM:
FINAL: X

SUMMARY: Energy Saving Fluor. Lamps

ITEM	QUANTITY		MATERIAL		LABOR		TOTAL COST
	NO.	MEAS	UNIT	COST	UNIT	COST	
Install 35 Watt Energy Saving Fluor. Lamps							
SUBGROUP							
Administration Buildings	464	EA	3.45	1,601	1.50	696	2,297
Dinning Facilities	38	EA	3.45	131	1.50	57	188
Housing Facilities	1592	EA	3.45	5,492	1.50	2,388	7,880
SUB-TOTAL				7,224		3,141	10,365

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CONSTRUCTION COST ESTIMATE

PREPARED: March 1994

PROJECT: Energy Savings Oppurtunity Survey

CONTRACT NO.: DACA 31-89-C-0198

LOCATION: Fort A.P. Hill, Virginia
AE PROJECT NO.:
AE: Engineering Applications Consultants, P.C.

ESTIMATOR: JS PRELIM:
CHECKED BY: VP FINAL: X

SUMMARY: Energy Saving Fluor. Lamps

ITEM	QUANTITY NO.	QUANTITY MEAS	MATERIAL UNIT	MATERIAL COST	LABOR UNIT	LABOR COST	TOTAL COST
SUBTOTAL PREV. PAGE				7,224		3,141	10,365
MARK-UP ON LABOR SUB-TOTAL	21.0%			---		660	660 11,025
TAXES ON MATERIAL SUB-TOTAL	5.0%			361		---	361 11,386
OVERHEAD SUB-TOTAL	15.0%						1,708 13,094
PROFIT SUB-TOTAL	12.0%						1,571 14,665
PRIME MARK-UP ON SUB SUB-TOTAL							14,665
GRAND TOTAL							14,700

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	Dinning	Housing	Admin	Field Latrines
Building Number	172	174	1,253	412
Floor Area (Ft**2)	4,272	4,800	5,000	143
Group Floor Area (Ft**2)	4,272	53,820	11,800	3,931

Existing Energy Usage- Bldg 1253	
MBtu/Yr	280.7
$/Yr	5,183
Existing Energy Usage- Bldg 174	
MBtu/Yr	378.7
$/Yr	6,992
Existing Energy Usage- Bldg 172	
MBtu/Yr	438.1
$/Yr	8,088

ECO	ECO Savings		Average Study Blg Savings		Average Study Blg Cost		Average Group Savings		Average Group Cost		No. of Units Per Study Bldg	Units per Study Blg Floor Area	Total Units Per Group
Subgroup A-1- Study Blg 1253	MBtu/Yr	$/Yr	MBtu/ft**2	$/Yr/ft**2	Materials $	Labor $	MBtu/Yr	$/Yr	Materials $	Labor $			
Low Flow Shower Heads	11.2	231	0.0031	0.0631	25	7	36.1	745	81	23	1	0.000273	3
Occupancy Sensors	31	573	0.0085	0.1566	616	56	99.9	1,847	1,986	181	8	0.002186	26
Compact Fluorescent Lights	6.93	127	0.0019	0.0347	192	4	22.3	409	619	13	8	0.002186	26
Energy Saving Fluorescent Lamps	22.8	420	0.0062	0.1148	497	216	73.5	1,354	1,602	696	144	0.039344	464
Exit Signs	5.38	150	0.0015	0.0410	500	100	17.3	484	1,612	322	4	0.001093	13
F32 T-8 Lighting System	39.7	733	0.0108	0.2003	2317	607	128.0	2,363	7,470	1,957	53	0.014481	171
Economizer Controls	24	444	0.0066	0.1213	2258	1280	77.4	1,431	7,280	4,127	1	0.000273	3
Daylight Dimming Controls	6.2	113	0.0017	0.0309	720	400	20.0	364	2,321	1,290	4	0.001093	13
Water Heater Timers	0.112	3	0.0000	0.0008	40	18	0.4	10	129	58	1	0.000273	3
Water Heater Insulation	1.17	24	0.0003	0.0066	25	18	3.8	77	81	58	1	0.000273	3

ECO	ECO Savings		Average Study Blg Savings		Average Study Blg Cost		Average Group Savings		Average Group Cost		No. of Units Per Study Bldg	Units per Study Blg Floor Area	Total Units Per Group
Subgroup B-1- Study Blg 174	MBtu/Yr	$/Yr	MBtu/ft**2	$/Yr/ft**2	Materials $/ft**2	Labor $/ft**2	MBtu/Yr	$/Yr	Materials $	Labor $			
Low Flow Shower Heads	37.2	769	0.0078	0.1602	150	42	417.1	8,622	1,682	471	6	0.00125	67
Compact Fluorescent Lighting	41.9	774	0.0087	0.1613	322	7	469.8	8,678	3,610	78	14	0.002917	157
Occupancy Sensors	55.4	1021	0.0115	0.2127	1078	98	621.2	11,448	12,087	1,099	14	0.002917	157
Water Heater Timer	1.13	23	0.0002	0.0048	40	18	12.7	258	449	202	1	0.000208	11
Energy Savings Fluorescent Lamps	19.6	361	0.0041	0.0752	490	213	219.8	4,048	5,494	2,388	142	0.029583	1,592
F32 T-8 Lighting System	12	221	0.0025	0.0460	2904	726	134.6	2,478	32,561	8,140	33	0.006875	370
Water Heater Insulation	1.17	24	0.0002	0.0050	25	18	13.1	269	280	202	1	0.000208	18

ECO	ECO Savings		Average Study Blg Savings		Average Study Blg Cost		Average Group Savings		Average Group Cost		No. of Units Per Study Bldg	Units per Study Blg Floor Area	Total Units Per Group
Subgroup D-1- Study Blg 172	MBtu/Yr	$/Yr	MBtu/ft**2	$/Yr/ft**2	Materials $	Labor $	MBtu/Yr	$/Yr	Materials $	Labor $			
Compact Fluorescent Lights	4.12	76	0.0010	0.0178	142	3	4.1	76	142.00	3.00	6	0.001404	6
Energy Savings Fluorescent Lamps	3.68	68	0.0009	0.0159	131	57	3.7	68	131.00	57.00	38	0.008895	38
Occupancy Sensors	15.46	285	0.0036	0.0667	1213	284	15.5	285	1,213.00	284.00	15	0.003511	15
Exit Sign Retrofit	14.08	260	0.0033	0.0609	1375	275	14.1	260	1,375.00	275.00	11	0.002575	11
Water Heater Timers	0.5	9	0.0001	0.0021	40	18	0.5	9	40.00	18.00	1	0.000234	1
DayLight Dimming Controls	0.56	10	0.0001	0.0023	180	100	0.6	10	180.00	100.00	1	0.000234	1

ECO	ECO Savings		Average Study Blg Savings		Average Study Blg Cost		Average Group Savings		Average Group Cost		No. of Units Per Study Bldg	Units per Study Blg Floor Area	Total Units Per Group
Subgroup E-2 Latrines	MBtu/Yr	$/Yr	MBtu/ft**2	$/Yr/ft**2	Materials $	Labor $	MBtu/Yr	$/Yr	Materials $	Labor $			
Compact Flourescent Lights	6.38	117	0.0446	0.8182	23	2	175.4	3,216	632.26	54.98	4	0.027972	119
Occupancy Sensors	2.12	40	0.0148	0.2797	154	14	58.3	1,100	4,233.38	384.85	2	0.013986	60

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New Buildings List- Buildings built after 1985 Fort A.P. Hill

SUBGROUP A-1

Bldg. No	Description		Floor Area (Ft**2)
1247	Entomology Facility		1,800
1252	General Inst. Bldg		5,000
1253	Range Control Bldg		5,000
		TOTAL	11,800

SUBGROUP B-1

Bldg. No	Description		Floor Area (Ft**2)
174	Guest House		4,800
290	Log Cabin Bullocks Lake		1,056
1350	FH NCO & ENL, QTRS 8		7,256
1351	FH NCO & ENL, QTRS 6		7,256
1352	FH NCO & ENL, QTRS 4		7,256
1353	FH NCO & ENL, QTRS 2		3,804
1354	FH Colonel, QTRS 1		2,553
1355	CO Grade & WO, QTRS 3		4,846
1356	FH NCO & ENL, QTRS 5		7,737
1357	FH NCO & ENL, QTRS 7		7,256
		TOTAL	53,820

SUBGROUP D-1

Bldg. No	Description		Floor Area (Ft**2)
172	Open Dinning NCO		4,272
		TOTAL	4,272

SUBGROUP E-1

Bldg. No	Description	Floor Area (Ft**2)
1241	Detached Latrine/Shwr	533

SUBGROUP E-2

Bldg. No	Description		Floor Area (Ft**2)
412	Detached Latrine TA12		143
413	Detached Latrine TA12		143
529	Detached Latrine Area 15		90
531	Detached Latrine TA15		143
733	Detached Latrine TNG 18		90
745	Detached Latrine TNG 14		144
746	Detached Latrine Rapp. Compound		144
748	Detached Latrine TA 18		143
826	Detached Latrine Range 42		143
828	Detached Latrine TNG 28		144
839	Detached Latrine at Repell. Twr		143
924	Detached Latrine		108
928	Detached Latrine		144
1008	Detached Latrine- Range 25		143
1024	Detached Latrine-Range 24		144
1108	Detached Latrine-Range 28P		144
1109	Detached Latrine-Range 28P		144
1110	Detached Latrine-Range 28P		144
1114	Detached Latrine		144
1116	Detached Latrine-Range 33		143
1202	Detached Latrine- Range 7		143
1254	Detached Latrine-Range 37		143
1256	Detached Latrine		108
1263	Detached Latrine-Range 6		143
1403	Detached Latrine-Tr Area 5		90
1405	Detached Latrine-Tr Area 3		90
1428	Detached Latrine-Tr Area 3		144
1619	Detached Latrine-Tr Area 21		90
1670	Detached Latrine-Tr Area 21		144
S 1272	Detached Latrine- Range 33		108
		TOTAL	3,931

Shut Down Energy to Hotwater Heaters or Modify Controls

LIFE CYCLE COST ANALYSIS SUMMARY
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)

LOCATION: Fort A.P. Hill, Virginia   REGION: 3   PROJECT NO.: DACA 31-89-C-0198
PROJECT TITLE: Fort A.P. Hill- Energy Engineering Analysis Program   FISCAL YEAR: 1994
DISCRETE PORTION NAME: Shut Down Energy To Hotwater Heaters or Modify Controls
ANALYSIS DATE: January 1994   ECONOMIC LIFE (YRS 20   PREPARER: JJS

1. INVESTMENT COSTS:

A. CONSTRUCTION COST	$	908	
B. SIOH	$	50	
C. DESIGN COST	$	54	
D. TOTAL COST (1A+1B+1C)	$	1,012	
E. SALVAGE VALUE OF EXISTING EQUIPMENT			
F. PUBLIC UTILITY COMPANY REBATE			
G. TOTAL INVESTMENT (1D-1E-1F)			$1,012

2. ENERGY SAVINGS (+)/COST(-):

DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS- Oct 1992

ENERGY SOURCE	COST $/MBTU(1)	SAVING(S) MBTU/YR(2)	ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELEC	$20.67	13.0	$ 269	14.65	$ 3,937
B. DIST	$5.69		$		$
C. RESID			$		$
D. NG			$		$
E. LPG	$7.76		$		$
F. COAL			$		$
G. SOLAR			$		$
H. GEOTH			$		$
I. BIOMA			$		$
J. REFUS			$		$
K. WIND			$		$
L. OTHER			$		$
M. DEMAND SAVINGS			$		$
N. TOTAL		13	$ 269		$ 3,937

3. NON ENERGY SAVINGS (+) OR COST (-):

A. ANNUAL RECURRING (+/-)
(1) DISCOUNT FACTOR (TABLE A)
(2) DISCOUNTED SAVINGS/COST (3A X 3A1)

B. NON RECURRING SAVINGS (+) OR COST (-)

ITEM	SAVINGS(+) COST(-)(1)	YEAR OF OCCUR. (2)	DISCOUNT FACTOR(3)	DISCOUNTED SAV-INGS(+)COST(-)(4)
a.	$			$
b.	$			$
c.	$			$
d. TOTAL				$

C. TOTAL NON ENERGY DISCOUNTED SAVINGS (3A2+3Bd4)

4. SIMPLE PAYBACK 1G/(2N3+3A+(3Bd1/ECONOMIC LIFE)):	3.77 YEARS
5. TOTAL NET DISCOUNTED SAVINGS (2N5+3C):	$3,937
6. SAVINGS TO INVESTMENT RATION (SIR) 5/1G:	3.89
7. ADJUSTED INTERNAL RATE OF RETURN (AIRR):	7.31%

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CONSTRUCTION COST ESTIMATE

PREPARED: March 1994 SHEET 1 OF 2

PROJECT: Energy Savings Oppurtunity Survey

CONTRACT NO.: DACA 31-89-C-0198

LOCATION: Fort A.P. Hill, Virginia
AE PROJECT NO.: 92008
AE: Engineering Applications Consultants, P.C.

ESTIMATOR: JS PRELIM:
CHECKED BY: VP FINAL: X

SUMMARY: Shut Down Energy to Hotwater Heaters or Modify Controls

ITEM	QUANTITY		MATERIAL		LABOR		TOTAL
	NO.	MEAS	UNIT	COST	UNIT	COST	COST
Water Heater Timers							
SUBGROUP							
Housing Facilities	11	EA	40.00	440	18.25	201	641
SUB-TOTAL				440		201	641

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CONSTRUCTION COST ESTIMATE	PREPARED: March 1994	SHEET 2 OF 2
PROJECT: Energy Savings Oppurtunity Survey LOCATION: Fort A.P. Hill, Virginia AE PROJECT NO.: AE: Engineering Applications Consultants, P.C.	CONTRACT NO.: DACA 31-89-C-0198 ESTIMATOR: JS CHECKED BY: VP	PRELIM: FINAL: X

SUMMARY: Shut Down Energy to Hotwater Heaters or Modify Controls

ITEM	QUANTITY		MATERIAL		LABOR		TOTAL COST
	NO.	MEAS	UNIT	COST	UNIT	COST	
SUBTOTAL PREV. PAGE				440		201	641
MARK-UP ON LABOR SUB-TOTAL	21.0%			—		42	42 683
TAXES ON MATERIAL SUB-TOTAL	5.0%			22		—	22 705
OVERHEAD SUB-TOTAL	15.0%						106 811
PROFIT SUB-TOTAL	12.0%						97 908
PRIME MARK-UP ON SUB SUB-TOTAL							 908
GRAND TOTAL							900

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	Dinning	Housing	Admin	Field Latrines
Building Number	172	174	1,253	412
Floor Area (Ft**2)	4,272	4,800	5,000	143
Group Floor Area (Ft**2)	4,272	53,820	11,800	3,931

Existing Energy Usage- Bldg 1253	
MBtu/Yr	280.7
$/Yr	5,183
Existing Energy Usage- Bldg 174	
MBtu/Yr	378.7
$/Yr	6,992
Existing Energy Usage- Bldg 172	
MBtu/Yr	438.1
$/Yr	8,088

ECO	ECO Savings		Average Study Blg Savings		Average Study Blg Cost		Average Group Savings		Average Group Cost		No. of Units Per Study Bldg	Units per Study Blg Floor Area	Total Units Per Group
Subgroup A-1- Study Blg 1253	MBtu/Yr	$/Yr	MBtu/ft**2	$/Yr/ft**2	Materials $	Labor $	MBtu/Yr	$/Yr	Materials $	Labor $			
Low Flow Shower Heads	11.2	231	0.0031	0.0631	25	7	36.1	745	81	23	1	0.000273	3
Occupancy Sensors	31	573	0.0085	0.1566	616	56	99.9	1,847	1,988	181	8	0.002186	26
Compact Fluorescent Lights	6.93	127	0.0019	0.0347	192	4	22.3	409	619	13	8	0.002186	26
Energy Saving Fluorescent Lamps	22.8	420	0.0062	0.1148	497	216	73.5	1,354	1,602	696	144	0.039344	464
Exit Signs	5.38	150	0.0015	0.0410	500	100	17.3	484	1,612	322	4	0.001093	13
F32 T-8 Lighting System	39.7	733	0.0108	0.2003	2317	607	128.0	2,363	7,470	1,957	53	0.014481	171
Economizer Controls	24	444	0.0066	0.1213	2258	1280	77.4	1,431	7,280	4,127	1	0.000273	3
Daylight Dimming Controls	6.2	113	0.0017	0.0309	720	400	20.0	364	2,321	1,290	4	0.001093	13
Water Heater Timers	0.112	3	0.0000	0.0008	40	18	0.4	10	129	58	1	0.000273	3
Water Heater Insulation	1.17	24	0.0003	0.0066	25	18	3.8	77	81	58	1	0.000273	3

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ECO Subgroup B-1- Study Blg 174	ECO Savings MBtu/Yr	ECO Savings $/Yr	Average Study Blg Savings MBtu/ft**2	Average Study Blg Savings $/Yr/ft**2	Average Study Blg Cost Materials $/ft**2	Average Study Blg Cost Labor $/ft**2	Average Group Savings MBtu/Yr	Average Group Savings $/Yr	Average Group Cost Materials $	Average Group Cost Labor $	No. of Units Per Study Bldg	Units per Study Blg Floor Area	Total Units Per Group
Low Flow Shower Heads	37.2	769	0.0078	0.1602	150	42	417.1	8,622	1,682	471	6	0.00125	67
Compact Fluorescent Lighting	41.9	774	0.0087	0.1613	322	7	469.8	8,678	3,610	78	14	0.002917	157
Occupancy Sensors	55.4	1021	0.0115	0.2127	1078	98	621.2	11,448	12,087	1,099	14	0.002917	157
Water Heater Timer	1.13	23	0.0002	0.0048	40	18	12.7	258	449	202	1	0.000208	11
Energy Savings Fluorescent Lamps	19.6	361	0.0041	0.0752	490	213	219.8	4,048	5,494	2,388	142	0.029583	1,592
F32 T-8 Lighting System	12	221	0.0025	0.0460	2904	726	134.6	2,478	32,561	8,140	33	0.006875	370
Water Heater Insulation	1.17	24	0.0002	0.0050	25	18	13.1	269	280	202	1	0.000208	18

ECO Subgroup D-1- Study Blg 172	ECO Savings MBtu/Yr	ECO Savings $/Yr	Average Study Blg Savings MBtu/ft**2	Average Study Blg Savings $/Yr/ft**2	Average Study Blg Cost Materials $	Average Study Blg Cost Labor $	Average Group Savings MBtu/Yr	Average Group Savings $/Yr	Average Group Cost Materials $	Average Group Cost Labor $	No. of Units Per Study Bldg	Units per Study Blg Floor Area	Total Units Per Group
Compact Fluorescent Lights	4.12	76	0.0010	0.0178	142	3	4.1	76	142.00	3.00	6	0.001404	6
Energy Savings Fluorescent Lamps	3.68	68	0.0009	0.0159	131	57	3.7	68	131.00	57.00	38	0.008895	38
Occupancy Sensors	15.46	285	0.0036	0.0667	1213	284	15.5	285	1,213.00	284.00	15	0.003511	15
Exit Sign Retrofit	14.08	260	0.0033	0.0609	1375	275	14.1	260	1,375.00	275.00	11	0.002575	11
Water Heater Timers	0.5	9	0.0001	0.0021	40	18	0.5	9	40.00	18.00	1	0.000234	1
DayLight Dimming Controls	0.56	10	0.0001	0.0023	180	100	0.6	10	180.00	100.00	1	0.000234	1

ECO Subgroup E-2 Latrines	ECO Savings MBtu/Yr	ECO Savings $/Yr	Average Study Blg Savings MBtu/ft**2	Average Study Blg Savings $/Yr/ft**2	Average Study Blg Cost Materials $	Average Study Blg Cost Labor $	Average Group Savings MBtu/Yr	Average Group Savings $/Yr	Average Group Cost Materials $	Average Group Cost Labor $	No. of Units Per Study Bldg	Units per Study Blg Floor Area	Total Units Per Group
Compact Flourescent Lights	6.38	117	0.0446	0.8182	23	2	175.4	3,216	632.26	54.98	4	0.027972	119
Occupancy Sensors	2.12	40	0.0148	0.2797	154	14	58.3	1,100	4,233.38	384.85	2	0.013986	60

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New Buildings List- Buildings built after 1985 Fort A.P. Hill

SUBGROUP A-1

Bldg. No	Description		Floor Area (Ft**2)
1247	Entomology Facility		1,800
1252	General Inst. Bldg		5,000
1253	Range Control Bldg		5,000
		TOTAL	11,800

SUBGROUP B-1

Bldg. No	Description		Floor Area (Ft**2)
174	Guest House		4,800
290	Log Cabin Bullocks Lake		1,056
1350	FH NCO & ENL, QTRS 8		7,256
1351	FH NCO & ENL, QTRS 6		7,256
1352	FH NCO & ENL, QTRS 4		7,256
1353	FH NCO & ENL, QTRS 2		3,804
1354	FH Colonel, QTRS 1		2,553
1355	CO Grade & WO, QTRS 3		4,846
1356	FH NCO & ENL, QTRS 5		7,737
1357	FH NCO & ENL, QTRS 7		7,256
		TOTAL	53,820

SUBGROUP D-1

Bldg. No	Description		Floor Area (Ft**2)
172	Open Dinning NCO		4,272
		TOTAL	4,272

SUBGROUP E-1

Bldg. No	Description	Floor Area (Ft**2)
1241	Detached Latrine/Shwr	533

SUBGROUP E-2

Bldg. No	Description		Floor Area (Ft**2)
412	Detached Latrine TA12		143
413	Detached Latrine TA12		143
529	Detached Latrine Area 15		90
531	Detached Latrine TA15		143
733	Detached Latrine TNG 18		90
745	Detached Latrine TNG 14		144
746	Detached Latrine Rapp. Compound		144
748	Detached Latrine TA 18		143
826	Detached Latrine Range 42		143
828	Detached Latrine TNG 28		144
839	Detached Latrine at Repell. Twr		143
924	Detached Latrine		108
928	Detached Latrine		144
1008	Detached Latrine- Range 25		143
1024	Detached Latrine-Range 24		144
1108	Detached Latrine-Range 28P		144
1109	Detached Latrine-Range 28P		144
1110	Detached Latrine-Range 28P		144
1114	Detached Latrine		144
1116	Detached Latrine-Range 33		143
1202	Detached Latrine- Range 7		143
1254	Detached Latrine-Range 37		143
1256	Detached Latrine		108
1263	Detached Latrine-Range 6		143
1403	Detached Latrine-Tr Area 5		90
1405	Detached Latrine-Tr Area 3		90
1428	Detached Latrine-Tr Area 3		144
1619	Detached Latrine-Tr Area 21		90
1670	Detached Latrine-Tr Area 21		144
S 1272	Detached Latrine- Range 33		108
		TOTAL	3,931

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Hot Water Circulating Pump Controls

ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)

LOCATION: Fort A.P. Hill, Virginia REGION: 3 PROJECT NO.: DACA 31-89-C-0198
PROJECT TITLE: Fort A.P. Hill- Energy Engineering Analysis Program FISCAL YEAR: 1994
DISCRETE PORTION NAME: Hot Water Circulating Pump Controls
ANALYSIS DATE: January 1994 ECONOMIC LIFE (YRS) 10 PREPARER: JJS

1. INVESTMENT COSTS:

A. CONSTRUCTION COST	$	238	
B. SIOH	$	13	
C. DESIGN COST	$	14	
D. TOTAL COST (1A+1B+1C)	$	265	
E. SALVAGE VALUE OF EXISTING EQUIPMENT			
F. PUBLIC UTILITY COMPANY REBATE			
G. TOTAL INVESTMENT (1D-1E-1F)			$265

2. ENERGY SAVINGS (+)/COST(-):

DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS- Oct 1992

ENERGY SOURCE	COST $/MBTU(1)	SAVING(S) MBTU/YR(2)	ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELEC	$20.67	2.8	$ 58	14.65	$ 848
B. DIST	$5.69		$		$
C. RESID			$		$
D. NG			$		$
E. LPG	$7.76		$		$
F. COAL			$		$
G. SOLAR			$		$
H. GEOTH			$		$
I. BIOMA			$		$
J. REFUS			$		$
K. WIND			$		$
L. OTHER			$		$
M. DEMAND SAVINGS			$		$
N. TOTAL		3	$ 58		$ 848

3. NON ENERGY SAVINGS (+) OR COST (-):

A. ANNUAL RECURRING (+/-)
(1) DISCOUNT FACTOR (TABLE A)
(2) DISCOUNTED SAVINGS/COST (3A X 3A1)

B. NON RECURRING SAVINGS (+) OR COST (-)

ITEM	SAVINGS(+) COST(-)(1)	YEAR OF OCCUR. (2)	DISCOUNT FACTOR(3)	DISCOUNTED SAV-INGS(+)COST(-)(4)
a.	$			$
b.	$			$
c.	$			$
d. TOTAL				$

C. TOTAL NON ENERGY DISCOUNTED SAVINGS (3A2+3Bd4)

4. SIMPLE PAYBACK 1G/(2N3+3A+(3Bd1/ECONOMIC LIFE)):	4.59 YEARS
5. TOTAL NET DISCOUNTED SAVINGS (2N5+3C):	$848
6. SAVINGS TO INVESTMENT RATION (SIR) 5/1G:	3.20
7. ADJUSTED INTERNAL RATE OF RETURN (AIRR):	12.81%

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CONSTRUCTION COST ESTIMATE	Date Prepared: 1/27/94	
Activity and Location: Energy Savings Opportunity Survey Fort A. P. Hill, Virginia	Constr. Contact No. DACA 31-89-C-0198	I.D. No.
	Estimated By: EAC, P.C.	Category Code
Project: Hot Water Pump Controls	Status: Final	Job Order No.

ITEM DESCRIPTION	QUANTITY		PRIME CONTRACTOR				SUBCONTRACTOR				TOTAL COST
			MATERIAL COST		LABOR COST		MATERIAL COST		LABOR COST		
SUMMARY	NUMBER	UNIT	UNIT COST	TOTAL	UNIT COST	TOTAL	UNIT COST	TOTAL	UNIT COST	TOTAL	
Subtotal				134		38					
DIRECT COSTS				134		38					
SUBTOTAL (DIRECT COSTS)				134		38					
Material Tax & Labor Taxes			5.0%	7	21.0%	8					
Overhead			15.0%	20	15.0%	6					
SUBTOTAL				161		52					
Profit			12.0%	19	12.0%	6					
SUBTOTAL				180		58					
Prime Overhead on Sub											
SUBTOTAL											
Prime Profit on Sub											
TOTAL COST				180		58					$238

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CONSTRUCTION COST ESTIMATE	Date Prepared: 1/27/94	Reference: 1982 MMM Design Group\ 1992 RS Means
Activity and Location: Energy Savings Opportunity Survey Fort A. P. Hill, Virginia	Constr. Contact No. DACA 31-89-C-0198	I.D. No.
	Estimated By: EAC, P.C.	Category Code
Project: Hot Water Pump Controls	Status: Final	Job Order No.

ITEM DESCRIPTION	QUANTITY		PRIME CONTRACTOR				SUBCONTRACTOR				TOTAL COST
			MATERIAL COST		LABOR COST		MATERIAL COST		LABOR COST		
	NUMBER	UNIT	UNIT COST	TOTAL	UNIT COST	TOTAL	UNIT COST	TOTAL	UNIT COST	TOTAL	
Hot Water Pump Controls	1	EA	134.00	134	38.00	38					172
SUB - TOTAL				$134		$38					$172

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MMM DESIGN GROUP
A PROFESSIONAL CORPORATION
ARCHITECTS • ENGINEERS • PLANNERS

DESIGN ANALYSIS

☐ BUDGET
☐ PRELIMINARY
■ FINAL
☐ OTHER

PROJECT NAME: FORT A.P. HILL EEAP	PROJECT PART: HOT WATER PUMP CONTROL	SPEC. DIVISION: -
DEPARTMENT: MECHANICAL	COMPUTED BY: ENB DATE: 4-23-82	JOB NO: 4417.01
SHEET NO: OF:	CHECKED BY: DATE:	SHEET NO: OF:

IN BUILDINGS WHICH HAVE DOMESTIC HOT WATER CIRCULATING PUMPS TO MAINTAIN WATER TEMPERATURE, ENERGY CAN BE SAVED BY SHUTTING OFF THE PUMP DURING UNOCCUPIED HOURS. ASSUMING BUILDING OCCUPANCY OF 8 HOURS PER DAY, 5 DAYS PER WEEK, THE UNOCCUPIED TIME REPRESENTS 128 HRS. PER WEEK.

THE SAVINGS FROM EACH 1/6 Hp. CIRCULATING PUMP IS:

$1/6 \text{ Hp.} \times 2544 \text{ BTU}/_{\text{Hp}\cdot\text{HR}} \times 128 \text{ HR}/_{\text{WEEK}} \times 52 \text{ WEEKS}/_{\text{YR.}}$

$= 2,822,144 \text{ BTU}/_{\text{YR.}} = 2.8 \text{ MBTU}/_{\text{YR.}}$

~~THE APPROXIMATE COST OF A TIME CLOCK PLUS AN OPTIONAL THERMOSTATIC OVERRIDE (TO PREVENT PIPE FREEZING IN UNCONDITIONED SPACES) IS \$180 PER UNIT INSTALLED~~

ESCALATED COST = $180 \times 1.034 \times 1.067 \times 1.067 \times 1.034 = \$219.$

CONVERSION FROM PUMP MBTU TO GENERATING PLANT MBTU:

$2.8 \text{ MBTU} \left(\frac{11,600}{3,413}\right) = 9.5 \text{ MBTU/YR. SAVINGS}$

Replacement of Inefficient Light Fixtures

LIFE CYCLE COST ANALYSIS SUMMARY
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)

LOCATION: Fort A.P. Hill, Virginia REGION: 3 PROJECT NO.: DACA 31-89-C-0198
PROJECT TITLE: Fort A.P. Hill- Energy Engineering Analysis Program FISCAL YEAR: 1994
DISCRETE PORTION NAME: Replacement of Inefficient Light Fixtures
ANALYSIS DATE: January 1994 ECONOMIC LIFE (YRS) 15 PREPARER: JJS

1. INVESTMENT COSTS:

A. CONSTRUCTION COST	$	111,658	
B. SIOH	$	6,141	
C. DESIGN COST	$	6,699	
D. TOTAL COST (1A+1B+1C)	$	124,499	
E. SALVAGE VALUE OF EXISTING EQUIPMENT			
F. PUBLIC UTILITY COMPANY REBATE			
G. TOTAL INVESTMENT (1D-1E-1F)			$124,499

2. ENERGY SAVINGS (+)/COST(-):

DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS- Oct 1992

ENERGY SOURCE	COST $/MBTU(1)	SAVING(S) MBTU/YR(2)		ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)		DISCOUNTED SAVINGS(5)
A. ELEC	$20.67	1,420.4	$	29,360	11.77	$	345,563
B. DIST	$5.69		$			$	
C. RESID			$			$	
D. NG			$			$	
E. LPG	$7.76		$			$	
F. COAL			$			$	
G. SOLAR			$			$	
H. GEOTH			$			$	
I. BIOMA			$			$	
J. REFUS			$			$	
K. WIND			$			$	
L. OTHER			$			$	
M. DEMAND SAVINGS			$			$	
N. TOTAL		1,420	$	29,360		$	345,563

3. NON ENERGY SAVINGS (+) OR COST (-):

A. ANNUAL RECURRING (+/-)	$2,515		
(1) DISCOUNT FACTOR (TABLE A)		11.12	
(2) DISCOUNTED SAVINGS/COST (3A X 3A1)			$27,967

B. NON RECURRING SAVINGS (+) OR COST (-)

ITEM		SAVINGS(+) COST(-)(1)	YEAR OF OCCUR. (2)	DISCOUNT FACTOR(3)		DISCOUNTED SAV-INGS(+)COST(-)(4)
a. Maint. Fl. Fi	$	-4012	7	0.760	$	-3049
b.	$		6		$	
c.	$		9		$	
d. TOTAL		-4012			$	-3049

C. TOTAL NON ENERGY DISCOUNTED SAVINGS (3A2+3Bd4) $24,918

4. SIMPLE PAYBACK 1G/(2N3+3A+(3Bd1/ECONOMIC LIFE)):	3.94 YEARS
5. TOTAL NET DISCOUNTED SAVINGS (2N5+3C):	$370,481
6. SAVINGS TO INVESTMENT RATION (SIR) 5/1G:	2.98
7. ADJUSTED INTERNAL RATE OF RETURN (AIRR):	7.84%

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CONSTRUCTION COST ESTIMATE

Date Prepared: 3/1/94

Activity and Location:
Energy Savings Opportunity Survey
Fort A. P. Hill, Virginia

Constr. Contact No. DACA 31-89-C-0198

I.D. No.

Estimated By: EAC, P.C.

Category Code

Project: Inefficient Light Fixtures

Status: Final

Job Order No.

ITEM DESCRIPTION	QUANTITY		PRIME CONTRACTOR				SUBCONTRACTOR				TOTAL COST
			MATERIAL COST		LABOR COST		MATERIAL COST		LABOR COST		
SUMMARY	NUMBER	UNIT	UNIT COST	TOTAL	UNIT COST	TOTAL	UNIT COST	TOTAL	UNIT COST	TOTAL	
Subtotal				50,586		28,671					
DIRECT COSTS				50,586		28,671					
SUBTOTAL (DIRECT COSTS)				50,586		28,671					
Material Tax & Labor Taxes			5.0%	2,529	21.0%	6,021	5.0%		21.0%		
Overhead			15.0%	7,588	15.0%	4,301	15.0%		15.0%		
SUBTOTAL				60,703		38,992					
Profit			12.0%	7,284	12.0%	4,679	12.0%		12.0%		
SUBTOTAL				67,988		43,671					
Prime Overhead on Sub							5.0%		5.0%		
SUBTOTAL											
Prime Profit on Sub							5.0%		5.0%		
TOTAL COST				67,988		43,671					111,658

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CONSTRUCTION COST ESTIMATE	Date Prepared: 3/1/94	Reference: 1982 MMM Design/ 1992 R.S. Means
Activity and Location: Energy Savings Opportunity Survey Fort A. P. Hill, Virginia	Constr. Contact No. DACA 31-89-C-0198	I.D. No.
	Estimated By: EAC, P.C.	Category Code
Project: Inefficient Light Fixtures	Status: Final	Job Order No.

ITEM DESCRIPTION	QUANTITY		PRIME CONTRACTOR				SUBCONTRACTOR				TOTAL COST
			MATERIAL COST		LABOR COST		MATERIAL COST		LABOR COST		
	NUMBER	UNIT	UNIT COST	TOTAL	UNIT COST	TOTAL	UNIT COST	TOTAL	UNIT COST	TOTAL	
2 F32 T-8 SURFACE WRAP AROUND	85.00	EA	116.00	9,860	45.00	3,825					13,685
2 F32 T-8 SURFACE WET LABEL	102.00	EA	170.00	17,340	68.00	6,936					24,276
2 F32 T-8 INDUSTRIAL SUSPENDED	8.00	EA	113.00	904	48.00	384					1,288
1 F32 T-8 SURFACE WET LABEL	32.00	EA	160.00	5,120	56.00	1,792					6,912
1 F32 T-8 STRIP WITH REFLECTOR	9.00	EA	95.00	855	36.00	324					1,179
REMOVAL OF EXISTING FIXTURES	586.00				17.00	9,962					9,962
2 F34W Wall Mounted	52.00	EA	85.00	4,420	25.00	1,300					5,720
T-8 Lighting System Retrofit											
2 F32 T-8 SURFACE WRAP AROUND	226.00	EA	51.00	11,526	17.50	3,955					15,481
2 F32 T-8 WET LABEL	11.00	EA	51.00	561	17.50	193					754
SUB - TOTAL				$50,586		$28,671					$79,257

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ENGINEERING ANALYSIS

Sheet 1 of 1

Date: December 7, 1992 By: JS

Project: Energy Savings Opportunity Survey, Fort A.P. Hill, VA

Contract No.: DACA 31-89-C-0198 EAC Project No.: 92008.00

MAINTENANCE COSTS FOR FLOURESCENT FIXTURES over LIFE OF PROJECT (15 yrs)

USEFUL LIFE = 7.69 yrs, however practical experience HAS SHOWN LIFE IS REDUCED BECAUSE OF UTILITY LINE DISTURBANC

Therefore we will use about 7 yrs Avg LIFE.

ANNUAL MAINTENANCE COST (FOR LAMPS) = $\frac{\text{MAT}}{6.00}$ $\frac{\text{LAB}}{1.50}$ = 7.50

$\frac{\$7.50}{\text{LAMP}} \times \frac{535 \text{ LAMPS}}{\text{YR}} \cong \$4{,}012$ per Lot 1 change

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ENGINEERING ANALYSIS

Sheet 1 of 1

Date: December 7, 1992 By: JS

Project: Energy Savings Opportunity Survey, Fort A.P. Hill, VA

Contract No.: DACA 31-89-C-0198 EAC Project No.: 92008.00

LAMP ECONOMIC LIFE

F40T12 AVERAGE LIFE = 20,000 HRS

$$\text{OPERATING HOURS} = \frac{10\text{ HRS}}{\text{DAY}} \times \frac{5\text{ DAYS}}{\text{WK}} \times \frac{52\text{ WKS}}{\text{YR}} = 2600\text{ HRS/YR}$$

$$\text{USEFUL LIFE} = \frac{20{,}000\text{ HRS}}{2600\text{ HRS/YR}} = 7.69\text{ YRS}$$

INCANDESCENT (75 WATT BULB) LIFE = 750 HRS

$$\text{USEFUL LIFE} = \frac{750\text{ HRS}}{2600\text{ HR/YR}} = .3\text{ YRS}$$

ANNUAL MAINTENANCE COSTS:

$$266\text{ INCANDESCENT} \times \frac{3\text{ CHANGES}}{\text{YR}} \times \frac{3.15}{\text{BULB}} \cong 2515\text{ /YR}$$

Replace Ineffient Light Fixtures

Building Group	Study Building	Study Blg Floor Area Ft**2	Total Group Floor Area Ft**2	Incandescent to be Replaced Per Study Building	Proposed Fluorescent Per Study Blg.	Proposed Fluorescent Per Goup
B-2	1528	7,563	38,967	—	46	237
C-2	1290	9,306	9,306	15	13	13
D-2	820	6,176	18,176	37	31	91
E-1	821	5,984	8,484	176	130	184
				228		

Replace Ineffient Light Fixtures- Energy Savings

Building Group	Study Building	Study Blg Floor Area Ft**2	Total Group Floor Area Ft**2	Study Blg. Energy Savings KWH/Ft**2/Yr	Study Blg. Energy Savings Btu/Ft**2/Yr	Group Energy Savings KWH/Yr	Group Energy Savings MBtu/Yr
B-2	1528	7,563	38,967	1.5	5,148.3	58,780	200.6
C-2	1290	9,306	9,306	3.0	10,290.5	28,058	95.8
D-2	820	6,176	18,176	7.4	25,256.9	134,506	459.1
E-1	821	5,984	8,484	23.0	78,371.7	194,816	664.9
							1,420.4

Building 1528

Type of Lamp	# of Lamps		Watts per Lamp		Ballast Usage		KW		Hours/ Week		Weeks/ Month		Months/ Year		KWH/Year		$/KWH		$/Year	
F40 T-12 Fluorescent	88	x	40	x	1.25	=	4.40	x	168	x	4.345	x	12	=	38,542	x	0.063	=	2,428	Standard (Existing)
F32 T-8 Fluorescent	88	x	32	x	1.10	=	3.10	x	168	x	4.345	x	12	=	27,133	x	0.063	=	1,709	Replacement
													Energy Savings		11,408	KWH		=	719	$ Savings

Building 1290- Mens and Locker Room

Type of Lamp	# of Lamps		Watts per Lamp		Ballast Usage		KW		Hours/ Week		Weeks/ Month		Months/ Year		KWH/Year		$/KWH		$/Year	
Incandescent Lighting	11	x	100	x	1.00	=	1.10	x	168	x	4.345	x	12	=	9,635	x	0.063	=	607	Standard (Existing)
F32 T-8 Fluorescent	10	x	32	x	1.10	=	0.35	x	168	x	4.345	x	12	=	3,083	x	0.063	=	194	Replacement
													Energy Savings		6,552	KWH		=	413	$ Savings

Building 1290- Parts

Type of Lamp	# of Lamps		Watts per Lamp		Ballast Usage		KW		Hours/ Week		Weeks/ Month		Months/ Year		KWH/Year		$/KWH		$/Year	
Incandescent Lighting	11	x	300	x	1.00	=	3.30	x	168	x	4.345	x	12	=	28,906	x	0.063	=	1,821	Standard (Existing)
F32 T-8 Fluorescent	24	x	32	x	1.10	=	0.84	x	168	x	4.345	x	12	=	7,400	x	0.063	=	466	Replacement
													Energy Savings		21,506	KWH		=	1,355	$ Savings

Building 820

Type of Lamp	# of Lamps		Watts per Lamp		Ballast Usage		KW		Hours/ Week		Weeks/ Month		Months/ Year		KWH/Year		$/KWH		$/Year	
Incandescent Lighting	74	x	100	x	1.00	=	7.40	x	168	x	4.345	x	12	=	64,820	x	0.063	=	4,084	Standard (Existing)
F32 T-8 Fluorescent	62	x	32	x	1.10	=	2.18	x	168	x	4.345	x	12	=	19,117	x	0.063	=	1,204	Replacement
													Energy Savings		45,704	KWH		=	2,879	$ Savings

Building 821- Lavs and Toilets

Type of Lamp	# of Lamps		Watts per Lamp		Ballast Usage		KW		Hours/ Week		Weeks/ Month		Months/ Year		KWH/Year		$/KWH		$/Year	
Incandescent Lighting	88	x	100	x	1.00	=	8.80	x	168	x	4.345	x	12	=	77,084	x	0.063	=	4,856	Standard (Existing)
F32 T-8 Fluorescent	84	x	32	x	1.10	=	2.96	x	168	x	4.345	x	12	=	25,900	x	0.063	=	1,632	Replacement
													Energy Savings		51,184	KWH		=	3,225	$ Savings

Building 821- Drying,Shower, and Mechanical Room Areas

Type of Lamp	# of Lamps		Watts per Lamp		Ballast Usage		KW		Hours/ Week		Weeks/ Month		Months/ Year		KWH/Year		$/KWH		$/Year	
Incandescent Lighting	28	x	150	x	1.00	=	4.20	x	168	x	4.345	x	12	=	36,790	x	0.063	=	2,318	Standard (Existing)
F32 T-8 Fluorescent	26	x	32	x	1.10	=	0.92	x	168	x	4.345	x	12	=	8,017	x	0.063	=	505	Replacement
													Energy Savings		28,773	KWH		=	1,813	$ Savings

Building 821- Laundry Area

Type of Lamp	# of Lamps		Watts per Lamp		Ballast Usage		KW		Hours/ Week		Weeks/ Month		Months/ Year		KWH/Year		$/KWH		$/Year	
Incandescent Lighting	12	x	200	x	1.00	=	2.40	x	168	x	4.345	x	12	=	21,023	x	0.063	=	1,324	Standard (Existing)
F32 T-8 Fluorescent	6	x	32	x	1.10	=	0.21	x	168	x	4.345	x	12	=	1,850	x	0.063	=	117	Replacement
													Energy Savings		19,173	KWH		=	1,208	$ Savings

Building 821- Lavatory (Above Basin) Lights

Type of Lamp	# of Lamps		Watts per Lamp		Ballast Usage		KW		Hours/ Week		Weeks/ Month		Months/ Year		KWH/Year		$/KWH		$/Year	
Incandescent Lighting	76	x	100	x	1.00	=	7.60	x	168	x	4.345	x	12	=	66,572	x	0.063	=	4,194	Standard (Existing)
2F40 Wall Mount	76	x	34	x	1.25	=	3.23	x	168	x	4.345	x	12	=	28,293	x	0.063	=	1,782	Replacement
													Energy Savings		38,279	KWH		=	2,412	$ Savings

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ENGINEERING ANALYSIS

Sheet ____ of ____

By: JS

INEFFICIENT LIGHT FIXTURES

Project: Fort A. P. Hill ESOS

Date: 2-28-94

Contract No.: DACA 31-89-C-0198

EAC Project No.: 92008

BLG Subgroup B-2

REPLACE EXISTING 40 WATT FLUORESCENT TUBES WITH T-8 LAMPS AND ELECTRONIC BALLAST AND REUSE EXISTING FIXTURE LENS & HOUSING.

F-32 T-8 SURFACE WRAP AROUND - 226
(PARTS FOR RETROFIT)

F32 T-8 WET LABEL 11

TOTAL 237

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ENGINEERING ANALYSIS

Sheet ____ of ____

By: JS

Inefficient Light Fixtures

Project: Fort A. P. Hill ESOS

Date: 2-28-94

Contract No.: DACA 31-89-C-0198

EAC Project No.: 92008

BLg. GROUP - C-2

			TOTAL PER GROUP
1.	F32 T-8 Surface Wrap Around	-	
2.	F32 T-8 Surface Wet Label	-	2
3.	F32 T-8 INDUSTRIAL SUSPENDED	-	8
4.	1F32 T-8 SURFACE WET LABEL	- -	3
	2F34 W WALL MOUNTED	-	
		TOTAL	13

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ENGINEERING ANALYSIS

Sheet ____ of ____

By: JS

Inefficient Light Fixtures

Project: Fort A. P. Hill ESOS

Date: 2-28-94

Contract No.: DACA 31-89-C-0198

EAC Project No.: 92008

BLg. GROUP - D-2

TOTAL PER GROUP

1. F32T-8 Surface Wrap Around -
2. F32 T-8 Surface Wet Label - 91
3. F32 T-8 INDUSTRIAL SUSPENDED -
4. 1F32 T-8 SURFACE WET LABEL - -

2F34 W WALL MOUNTED -

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ENGINEERING ANALYSIS

Sheet ____ of ____

By: JS

Inefficient Light Fixtures

Project: Fort A. P. Hill ESOS

Date: 2-28-94

Contract No.: DACA 31-89-C-0198

EAC Project No.: 92008

BLg. GROUP - E-1

TOTAL PER GROUP

1. F32 T-8 Surface Wrap Around - 85
2. F32 T-8 Surface WET LABEL - 9
3. F32 T-8 INDUSTRIAL SUSPENDED -
4. 1F32 T-8 SURFACE WET LABEL - - 29
5. 2F34 W WALL MOUNTED - 52
6. F32 T-8 STRIP W/REFLECTOR 9

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DESIGN ANALYSIS

☐ PRELIMINARY
☐ FINAL
☐ OTHER: ______

SHEET NO. ______ OF ______

JOB NO. 441702

PROJECT NAME: EEA

ELECTRICAL DEPT.

SHEET NO. ______ OF ______

PROJECT LOCATION: BLDG 1528

LIGHTING CALCULATIONS

COMPUTED BY: CJA

DATE: 2-8-82

CHECKED BY: SGR

DATE: 3-11-82

Room Name: BEDROOM # 1

Length: 120' Width: 22' Height: 10.5'

Area: 2967 ft² Mounting Height: 8'

% Wall: 50 % Ceiling: 80

Room Index: 2 UF: .63 MF: .75 UFxMF: ______

Req'd FC: 20 Maintained FC: 19.4

FC 20 Sq. Ft. 2967 / UF x MF (.63) (.75) = Lumens 125,590

Lumens 125,590 / Lamp Lumens 3050 = Lamps 41.17

Fix's 20 Lamps/F 2 LL 3050 UF x MF (.63) (.75) / Sq. Ft. 2967 = Maint. FC

Fixture Type: SURFACE WRAPAROUND (2F40) Number of Fixtures: 20

Fixture Spacing: ______ Number of Rows: ______ Total Wattage: 1480 W

Remarks: BEDROOM # 2 IS THE SAME

Room Name: BATHROOM # 1

Length: 18' Width: 12' Height: ______

Area: 216 ft² Mounting Height: 8'

% Wall: 50 % Ceiling: 80

Room Index: 5.5 UF: .42 MF: .75 UFxMF: ______

Req'd FC: 20 Maintained FC: 18

FC 20 Sq. Ft. 216 / UF x MF (.42) (.75) = Lumens

Lumens 13714 / Lamp Lumens 3050 = Lamps 4.49

Fix's 2 Lamps/F 2 LL 3050 UF x MF (.42) (.75) / Sq. Ft. 216 = Maint. FC

Fixture Type: SURFACE WRAPAROUND (2F40) Number of Fixtures: 2

Fixture Spacing: ______ Number of Rows: ______ Total Wattage: 148 W

Remarks: BATHROOM # 2 IS THE SAME

Room Name: SHOWER

Length: 17' Width: 8' Height: ______

Area: 136 Mounting Height: 8'

% Wall: 30 % Ceiling: 70

Room Index: 7.35 UF: .26 MF: .75 UFxMF: ______

Req'd FC: 20 Maintained FC: 17

FC 20 Sq. Ft. 136 / UF x MF (.26) (.75) = Lumens

Lumens 13949 / Lamp Lumens 3050 = Lamps 4.57

Fix's 2 Lamps/F 2 LL 3050 UF x MF (.26) (.75) / Sq. Ft. 136 = Maint. FC

Fixture Type: SURFACE - WETLABEL (2F40) Number of Fixtures: 2

Fixture Spacing: ______ Number of Rows: ______ Total Wattage: 148 W

Remarks: ______

Room Name: ______

Length: ______ Width: ______ Height: ______

Area: ______ Mounting Height: ______

% Wall: ______ % Ceiling: ______

Room Index: ______ UF: ______ MF: ______ UFxMF: ______

Req'd FC: ______ Maintained FC: ______

FC ______ Sq. Ft. ______ / UF x MF ______ = Lumens

Lumens ______ / Lamp Lumens ______ = Lamps

Fix's ______ Lamps/F ______ LL ______ UF x MF ______ / Sq. Ft. ______ = Maint. FC

Fixture Type: ______ Number of Fixtures: 40

Fixture Spacing: ______ Number of Rows: ______ Total Wattage: ______

Remarks: ______

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ENGINEERING ANALYSIS

Sheet 1 of ____

By: JS

BLdg 1290

Project: Fort A. P. Hill ESOS Date: 2-28-94

Contract No.: DACA 31-89-C-0198 EAC Project No.: 92008

PROPOSED

MENS ROOM - 2F40 SURFACE WET LABEL - 3 FIXTURES
LOCKER ROOM - 2F40 SURFACE WET LABEL - 2 FIXTURES
PARTS & TOOLS - 2F40 INDUSTRIAL - 8 FIXTURES

EXISTING

MENS ROOM - 5-100W A-19 (INCAND) (5 LAMPS)
LOCKER ROOM - 2-100W A-19 (INCAND) (6 LAMPS)
PARTS & TOOLS - 8 - 300W I. FLOODS

PROPOSE

MENS RM - 2F32-T-8 DAMP LOCATION - 3 FIXT.
LOCKER RM " " 2 FIXT.
PARTS & TOOLS - 2F32 T-8 INDUSTRIAL - 8 FIXT

9f

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DESIGN ANALYSIS

☐ PRELIMINARY ☐ FINAL ☐ OTHER:

SHEET NO. ____ OF ____
JOB NO. 4417 02

PROJECT NAME: EFA A.P HILL

ELECTRICAL DEPT.
SHEET NO. ____ OF ____

PROJECT LOCATION: BLDG 1290
LIGHTING CALCULATIONS

COMPUTED BY: CJA — DATE: 2-8-82
CHECKED BY: SGR — DATE: 3-11-82

Room Name: MENS TOILET
Length: 11' Width: 13' Height: 12.5
Area: 143 ft² Mounting Height: 10'
% Wall: 50 % Ceiling: 50
Room Index: 8 UF: .19 MF: .7 UFxMF
Req'd FC: 8 Maintained FC: 8.1

FC 8 × Sq. Ft. 142 / UF x MF .133 = Lumens
Lumens 8601 / Lamp Lumens 1750 = Lamps 5
Fix's 5 × Lamps/F 1 × LL 1750 × UF x MF .133 / Sq. Ft. 143 = Maint. FC 8.

Fixture Type: ART METAL 100 W — Number of Fixtures: 5
Fixture Spacing: ____ Number of Rows: ____ Total Wattage: 1000
Remarks: CALCULATION OF EXISTING FC

Room Name: MENS TOILET
Length: 11' Width: 13' Height: 12.5
Area: 143 ft² Mounting Height: 10'
% Wall: 50 % Ceiling: 50
Room Index: 8 UF: .22 MF: .7 UFxMF
Req'd FC: 10 Maintained FC: 9.8

FC 10 × Sq. Ft. 143 / UF x MF (.22) (.7) = Lumens
Lumens 9286 / Lamp Lumens 3050 = Lamps 3
Fix's 3 × Lamps/F 1 × LL 3050 × UF x MF (.22) (.7) / Sq. Ft. 143 = Maint. FC 9.8

Fixture Type: 1F40 SURFACE WET LABEL — Number of Fixtures: 3
Fixture Spacing: ____ Number of Rows: ____ Total Wattage: 222 W
Remarks: PROPOSED

Room Name: LOCKER ROOM
Length: 8' Width: 10' Height: 12.5
Area: 80 ft² Mounting Height: 10'
% Wall: 30 % Ceiling: 50
Room Index: 11 UF: .14 MF: .7 UFxMF
Req'd FC: 13 Maintained FC: 12.8

FC 13 × Sq. Ft. 80 / UF x MF (.14)(.7) = Lumens 10612
Lumens 10612 / Lamp Lumens 1750 = Lamps 6
Fix's 2 × Lamps/F 3 × LL 1750 × UF x MF (.14) (.7) / Sq. Ft. 80 = Maint. FC 12.

Fixture Type: ART METAL I.F. 100 W — Number of Fixtures: 2
Fixture Spacing: ____ Number of Rows: ____ Total Wattage: 600
Remarks: CALCULATION OF EXISTING FC

Room Name: LOCKER ROOM
Length: 8' Width: 10' Height: 12.5
Area: 80 ft² Mounting Height: 10'
% Wall: 30 % Ceiling: 50
Room Index: 11 UF: .18 MF: .7 UFxMF
Req'd FC: 15 Maintained FC: 19.2

FC 15 × Sq. Ft. 80 / UF x MF (.18)(.7) = Lumens
Lumens 9524 / Lamp Lumens 3050 = Lamps 3.1
Fix's 2 × Lamps/F 2 × LL 3050 × UF x MF (.18) (.7) / Sq. Ft. 80 = Maint. FC 19.2

Fixture Type: 2F40 SURFACE WET LABEL — Number of Fixtures: 2
Fixture Spacing: ____ Number of Rows: ____ Total Wattage: 148 W 42
Remarks: PROPOSED

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DESIGN ANALYSIS

☐ PRELIMINARY ☐ FINAL ☐ OTHER:

SHEET NO. ____ OF ____
JOB NO. 4417 02
ELECTRICAL DEPT.
SHEET NO. ____ OF ____

PROJECT NAME: EEA A.P. HILL
PROJECT LOCATION: BLDG 1290
LIGHTING CALCULATIONS
COMPUTED BY: CJA — DATE: 2-8-82
CHECKED BY: SGR — DATE: 3-11-82

Room Name: PARTS & TOOLS
Length: 19' Width: 19' Height: 12'
Area: 228 ft² Mounting Height: 9.5'
% Wall: 30 % Ceiling: 50
Room Index: 6.5 UF: .37 MF: .65 UFxMF
Req'd FC: 54 IFS Maintained FC: 53.5

FC 54 Sq. Ft. 228 / UF x MF .24 = Lumens 51193
Lumens 51193 / Lamp Lumens 6360 = Lamps 8
Fix's 8 Lamps/F 1 LL 6360 UF x MF .24 / Sq. Ft. 228 = Maint. FC 53.

Fixture Type: I F 300 W — Number of Fixtures: 8
Fixture Spacing: ____ Number of Rows: ____ Total Wattage: 2400 W
Remarks: CALCULATION OF EXISTING FC

Room Name: PARTS & TOOLS
Length: ____ Width: 19' Height: 12'
Area: 228 ft² Mounting Height: 9.5
% Wall: 30 % Ceiling: 50
Room Index: 6.5 UF: .35 MF: .65 UFxMF
Req'd FC: 50 Maintained FC: 48.7

FC 50 Sq. Ft. 228 / UF x MF .2275 = Lumens
Lumens 50110 / Lamp Lumens 3050 = Lamps 16.4
Fix's 8 Lamps/F 2 LL 3050 UF x MF .2275 / Sq. Ft. 228 = Maint. FC

Fixture Type: 2F48 INDUSTRIAL (SUSPENDED) — Number of Fixtures: 8
Fixture Spacing: ____ Number of Rows: ____ Total Wattage: 592 W
Remarks: PROPOSED

Room Name: BATTERY ROOM
Length: 13' Width: 7' Height: 12'
Area: 91 ft² Mounting Height: 9.5
% Wall: 30 % Ceiling: 50
Room Index: 10 UF: .24 MF: .65 UFxMF
Req'd FC: 32 IES Maintained FC: 31.3

FC 32 Sq. Ft. 91 / UF x MF (.23) (.65) = Lumens 19478
Lumens 19478 / Lamp Lumens 6360 = Lamps 3
Fix's 3 Lamps/F 1 LL 6360 UF x MF (.23)(.65) / Sq. Ft. 91 = Maint. FC 31.

Fixture Type: I.F. 300 W — Number of Fixtures: 3
Fixture Spacing: ____ Number of Rows: ____ Total Wattage: 900 W
Remarks: CALCULATION OF EXISTING FC

Room Name: BATTERY ROOM
Length: 13' Width: 7' Height: 12'
Area: 91 ft² Mounting Height: 9.5
% Wall: 30 % Ceiling: 50
Room Index: 10 UF: .23 MF: .65 UFxMF
Req'd FC: 30 Maintained FC: 30

FC 30 Sq. Ft. 91 / UF x MF (.23) (.65) = Lumens
Lumens 18261 / Lamp Lumens 3050 = Lamps 6
Fix's 3 Lamps/F 2 LL 3050 UF x MF (.23) (.65) / Sq. Ft. 91 = Maint. FC

Fixture Type: ____ Number of Fixtures: 3
Fixture Spacing: ____ Number of Rows: ____ Total Wattage: 41
Remarks: BECAUSE OF LOW HOURS OF OPERATION WE WILL NOT CHANGE THE LIGHTING

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DESIGN ANALYSIS

☐ PRELIMINARY ☐ FINAL ☐ OTHER:

SHEET NO. ____ OF ____

JOB NO. 4417.02

ELECTRICAL DEPT.

SHEET NO. ____ OF ____

PROJECT NAME: FEA

PROJECT LOCATION: BLDG 820

COMPUTED BY: CJA

DATE:

LIGHTING CALCULATIONS

CHECKED BY: SGR

DATE: 3-11-82

Room Name: KITCHEN 01

Length: 35' Width: 16' Height:

Area: 560 ft² Mounting Height: 8'

% Wall: 30 % Ceiling: 70

Room Index: 3.7 UF: .52 MF: .7 UFxMF:

Req'd FC: Maintained FC:

FC 4h Sq. Ft. 560 / UF x MF (.52)(.7) = Lumens 73500

Lumens / Lamp Lumens 1750 = Lamps 42

Fix's 21 Lamps/F 2 LL UF x MF / Sq. Ft. = Maint. FC

Fixture Type: I.F. 100 W Number of Fixtures: 21

Fixture Spacing: Number of Rows: Total Wattage: 4200

Remarks: CALCULATION OF EXISTING FC

Room Name: KITCHEN 01

Length: Width: Height:

Area: 560 ft² Mounting Height:

% Wall: 30 % Ceiling: 70

Room Index: 3.7 UF: .43 MF: .7 UFxMF:

Req'd FC: 50 Maintained FC:

FC 50 Sq. Ft. 560 / UF x MF .301 = Lumens

Lumens / Lamp Lumens 3050 = Lamps 30

Fix's 15 Lamps/F 2 LL UF x MF / Sq. Ft. = Maint. FC

Fixture Type: 2F40 SURFACE WETLABEL Number of Fixtures: 15

Fixture Spacing: Number of Rows: Total Wattage:

Remarks: PROPOSED

Room Name: KITCHEN (2)

Length: 14' Width: 10' Height:

Area: 140 ft² Mounting Height: 8'

% Wall: 30 % Ceiling: 70

Room Index: .7 UF: .57 MF: .7 UFxMF:

Req'd FC: Maintained FC:

FC 60 Sq. Ft. 140 / UF x MF (.57)(.7) = Lumens 21000

Lumens / Lamp Lumens 1750 = Lamps 12

Fix's Lamps/F 2 LL UF x MF / Sq. Ft. = Maint. FC

Fixture Type: Number of Fixtures: 6

Fixture Spacing: Number of Rows: Total Wattage: 1200

Remarks: CALCULATION OF EXISTING FC

Room Name: KITCHEN (2)

Length: 14' Width: 10' Height:

Area: 140 ft² Mounting Height:

% Wall: 30 % Ceiling: 70

Room Index: .7 UF: .27 MF: .7 UFxMF:

Req'd FC: 50 Maintained FC:

FC 50 Sq. Ft. 140 / UF x MF (.27)(.7) = Lumens

Lumens / Lamp Lumens 3050 = Lamps 12

Fix's 6 Lamps/F 2 LL UF x MF / Sq. Ft. = Maint. FC

Fixture Type: 2F40 SURFACE WET LABEL Number of Fixtures: 6

Fixture Spacing: Number of Rows: Total Wattage: 43

Remarks: PROPOSED

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Burke, Virginia 22015-1630
(703) 978-0923

ENGINEERING ANALYSIS

Sheet ____ of ____

By: JS

Blg 820

Project: Fort A. P. Hill ESOS

Date: 2-28-94

Contract No.: DACA 31-89-C-0198

EAC Project No.: 92008

Space	Existing	Number Fixtures	Number Lamps	Proposed	# Fixtures
Kitchen (1)	100W Flood	21	42	2F40 Wet Label	15
Kitchen (2)	100W Flood	6	12	2F40 Wet Label	6
Kitchen (3)	100W Flood	10	20	2F40 Wet Label	10
		37	74		31

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DESIGN ANALYSIS

☑ BUDGET
☐ PRELIMINARY
☐ FINAL
☐ OTHER:

SHEET NO. ____ OF ____
JOB NO. 4417.02

PROJECT NAME: FCH

ELECTRICAL DEPT.
SHEET NO. ____ OF ____

PROJECT LOCATION: BLDG 820

COMPUTED BY: CJA

DATE:

LIGHTING CALCULATIONS

CHECKED BY: SGR

DATE: 3-11-82

Room Name: KITCHEN (2)
Length: 26' Width: 13' Height:
Area: 338 ft Mounting Height: 9'
% Wall: 30 % Ceiling: 70
Room Index: 4.6 UF: .56 MF: .7 UFxMF:
Req'd FC: Maintained FC:

FC 41 Sq. Ft. 140 / UF x MF (.56)(.7) = Lumens 35000
Lumens / Lamp Lumens 1750 = Lamps 20
Fix's 10 Lamps/F 2 LL UF x MF / Sq. Ft. = Maint. FC

Fixture Type: I.E. 100W Number of Fixtures: 10
Fixture Spacing: Number of Rows: Total Wattage: 2000 W
Remarks: CALCULATION OF EXISTING FC

Room Name: KITCHEN (2)
Length: Width: Height:
Area: 338 ft Mounting Height:
% Wall: 30 % Ceiling: 70
Room Index: 4.1 UF: .38 MF: .7 UFxMF:
Req'd FC: 50 Maintained FC:

FC 50 Sq. Ft. 338 / UF x MF (.38)(.7) = Lumens
Lumens / Lamp Lumens 3050 = Lamps 20.8
Fix's 10 Lamps/F 2 LL UF x MF / Sq. Ft. = Maint. FC

Fixture Type: 2FA0 SURFACE W/ WET LABEL Number of Fixtures: 10
Fixture Spacing: Number of Rows: Total Wattage:
Remarks: PROPOSED

Room Name:
Length: Width: Height:
Area: Mounting Height:
% Wall: % Ceiling:
Room Index: UF: MF: UFxMF:
Req'd FC: Maintained FC:

FC Sq. Ft. / UF x MF = Lumens
Lumens / Lamp Lumens = Lamps
Fix's Lamps/F LL UF x MF / Sq. Ft. = Maint. FC

Fixture Type: Number of Fixtures:
Fixture Spacing: Number of Rows: Total Wattage:
Remarks:

Room Name:
Length: Width: Height:
Area: Mounting Height:
% Wall: % Ceiling:
Room Index: UF: MF: UFxMF:
Req'd FC: Maintained FC:

FC Sq. Ft. / UF x MF = Lumens
Lumens / Lamp Lumens = Lamps
Fix's Lamps/F LL UF x MF / Sq. Ft. = Maint. FC

Fixture Type: Number of Fixtures:
Fixture Spacing: Number of Rows: Total Wattage:
Remarks:

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ENGINEERING ANALYSIS

Sheet ____ of ____

By: JS

BLg 821

Project: Fort A. P. Hill ESOS

Date: 2-28-94

Contract No.: DACA 31-89-C-0198

EAC Project No.: 92008

Space	Exist.	# Fixt.	Proposed	# Fixt.	Total Fixt.
Toilet, Lav's* Urinals	100W	4- ~~80~~ (100 4	2F40 Surface Wrap Around	4 2-Vestibule	80 4
Shower **	150W	3 (12)	1 F40 Surface Wet Label	3	12
Drying (per room - 2 rooms)	150W	4 (8)	1 F40 Surface Wet Label	4	8
Laundry (per Bay - 2 Bays)	200W	6 (12)	2 F40 Surface Wet Label	3	6
Mechanical Room	150W	8	1 F40 Strip w/Reflector	6	6
					116

* Per Bay — 10 bays
** Per Shower — 4 showers

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DESIGN ANALYSIS ☐ FINAL ☐ OTHER:

JOB NO. 4417 02

PROJECT NAME: FFA A.P. HILL

ELECTRICAL DEPT.
SHEET NO. ___ OF ___

PROJECT LOCATION: BLDG 821

COMPUTED BY: CJA — DATE 1-29-82

LIGHTING CALCULATIONS

CHECKED BY: S.G.R. — DATE 3-11-82

Room Name: TOILET, LAVATORIES & URINALS VESTIBULE
Length: 10' Width: 31' Height: 10.5'
Area: 310 ft² Mounting Height: 8'
% Wall: 50 % Ceiling: 50
Room Index: 5.3 UF: .49 MF: .7 UFxMF: .315
Req'd FC: 15 Maintained FC: 15

FC 15 × Sq. Ft. 310 / UF × MF (.49)(.7) = Lumens 13557
Lumens 13557 / Lamp Lumens 1750 = Lamps 7.7
Fix's 4 × Lamps/F 2 × LL 1750 × UF × MF (49)(.7) / Sq. Ft. 310 = Maint. FC

Fixture Type: ART METAL 602 (100W) Number of Fixtures: 4
FIXT. TYPE IS APPROX. THE SAME AS THE EXISTING ONE
Fixture Spacing: ___ Number of Rows: ___ Total Wattage: 800 W + 400

Remarks: CALCULATION OF EXISTING FC (PER BAY) (10 BAYS) VEST.

Room Name: TOILET, LAVATORIES & URINALS
Length: 10' Width: 31' Height: 10.5'
Area: 310 Mounting Height: 8'
% Wall: 50 % Ceiling: 50
Room Index: 5.3 UF: .41 MF: .7 UFxMF: .287
Req'd FC: 15 Maintained FC: 23

FC 15 × Sq. Ft. 310 / UF × MF (.41)(.7) = Lumens
Lumens 16203 / Lamp Lumens 3050 = Lamps 5.3
Fix's 4 × Lamps/F 2 × LL 3050 × UF × MF .287 / Sq. Ft. 310 = Maint. FC 7.3

Fixture Type: 2FAO SURFACE — WRAPAROUND Number of Fixtures: 4 + 2 = 6 VESTIBULE
Fixture Spacing: ___ Number of Rows: ___ Total Wattage: W

Remarks: PROPOSED. (PER BAY) 110 ...

Room Name: SHOWER
Length: 10' Width: 18' Height: 10.5'
Area: 180 ft² Mounting Height: 8'
% Wall: 30 % Ceiling: 50
Room Index: 6.22 UF: .26 MF: .7 UFxMF: ___
(FROM IES. — 10%)
Req'd FC: 9 Maintained FC: 8.7

FC 9 × Sq. Ft. 180 / UF × MF (.26)(.7) = Lumens 8901
Lumens 8901 / Lamp Lumens 2880 = Lamps 3
Fix's 3 × Lamps/F 1 × LL 2880 × UF × MF (.26)(.7) / Sq. Ft. 180 = Maint. FC 8.7

Fixture Type: I.F (150W) Number of Fixtures: 3
Fixture Spacing: ___ Number of Rows: ___ Total Wattage: 450 W

Remarks: CALCULATION OF EXISTING FC (PER ROOM) (4 ROOMS)

Room Name: SHOWER
Length: 10' Width: 18' Height: 10.5'
Area: 180 ft² Mounting Height: 8'
% Wall: 30 % Ceiling: 50
Room Index: 6.22 UF: .28 MF: .7 UFxMF: .196
Req'd FC: 9 Maintained FC: 9.9

FC 9 × Sq. Ft. 180 / UF × MF .196 = Lumens 8265
Lumens 8265 / Lamp Lumens 3050 = Lamps 2.7
Fix's 3 × Lamps/F 1 × LL 3050 × UF × MF .196 / Sq. Ft. 180 = Maint. FC 9.9

Fixture Type: 1FAO SURFACE WET LABEL Number of Fixtures: 3
Fixture Spacing: ___ Number of Rows: ___ Total Wattage: 45

Remarks: PROPOSED (PER ROOM) (4 ROOMS)

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☐ FINAL
☐ OTHER:

JOB NO. 441702

PROJECT NAME: A. P. HILL

ELECTRICAL DEPT.

SHEET NO. ____ OF ____

PROJECT LOCATION: BLDG 821

LIGHTING CALCULATIONS

COMPUTED BY: CJA | DATE: 1-29-82

CHECKED BY: SGR | DATE: 3-11-82

Room Name: DRYING
Length: 21' Width: 12' Height: 10.5'
Area: 252 ft² Mounting Height: 8'
% Wall: 30 % Ceiling: 50
Room Index: 5.23 UF: .26 MF: .7 UFxMF: .224
Req'd FC: 9 YES. Maintained FC: 8.3

FC 9 × Sq. Ft. 252 / UF x MF .182 = Lumens 12462

Lumens 12462 / Lamp Lumens 2880 = Lamps 4

Fix's 4 × Lamps/F 1 × LL 2880 × UF x MF .182 / Sq. Ft. 252 = Maint. FC 8.3

Fixture Type: I. F 150 W Number of Fixtures: 4
Fixture Spacing: Number of Rows: Total Wattage: 600 W
Remarks: CALCULATION OF EXISTING FC (PER ROOM) 12 ROOMS)

Room Name: DRYING
Length: 21' Width: 12' Height: 10.5'
Area: 252 Mounting Height: 8'
% Wall: 30 % Ceiling: 50
Room Index: 5.23 UF: .32 MF: .7 UFxMF: .224
Req'd FC: 9 Maintained FC: 11.

FC 9 × Sq. Ft. 252 / UF x MF .224 = Lumens

Lumens 10125 / Lamp Lumens 3050 = Lamps 3.3

Fix's 4 × Lamps/F 1 × LL 3050 × UF x MF .224 / Sq. Ft. 252 = Maint. FC

Fixture Type: 1F40 SURFACE WETLABOL Number of Fixtures: 4
Fixture Spacing: Number of Rows: Total Wattage:
Remarks: PROPOSED (PER ROOM) 12 ROOMS)

Room Name: LAUNDRY
Length: 10' Width: 31' Height: 10.5'
Area: 310 Mounting Height: 8'
% Wall: 30 % Ceiling: 50
Room Index: 5.3 UF: .24 MF: .7 UFxMF: .168
Req'd FC: 9.36 Maintained FC: 9.3

FC 9.36 × Sq. Ft. 310 / UF x MF .168 = Lumens

Lumens 17271 / Lamp Lumens 2880 = Lamps 6

Fix's 6 × Lamps/F 1 × LL 2880 × UF x MF .168 / Sq. Ft. 310 = Maint. FC 9.3

Fixture Type: 200 W Number of Fixtures: 6
Fixture Spacing: Number of Rows: Total Wattage: 1200 W
Remarks: CALC. OF EXISTING FC (PER BAY) 12 BAYS)

Room Name: LAUNDRY
Length: 10' Width: 31' Height: 10.5'
Area: 310 Mounting Height: 8'
% Wall: 30 % Ceiling: 50
Room Index: 5.3 UF: .32 MF: .7 UFxMF: .168
Req'd FC: 10 Maintained FC: 9.9

FC 10 × Sq. Ft. 310 / UF x MF .168 = Lumens 18452.

Lumens 18452 / Lamp Lumens 3050 = Lamps 6

Fix's 3 × Lamps/F 2 × LL 3050 × UF x MF .168 / Sq. Ft. 310 = Maint. FC 99

Fixture Type: 2F40 SURFACE WETLABEL Number of Fixtures: 3
Fixture Spacing: Number of Rows: Total Wattage: 46
Remarks: PROPOSED (PER BAY) 12 BAYS)

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DESIGN ANALYSIS ☐ FINAL ☐ OTHER:

SHEET NO. ___ OF ___
JOB NO. 4417.02
ELECTRICAL DEPT.
SHEET NO. ___ OF ___

PROJECT NAME: FFA
PROJECT LOCATION: BLDG 621
LIGHTING CALCULATIONS
COMPUTED BY: CJA — DATE: 1-29-82
CHECKED BY: SGR — DATE: 3-11-82

Room Name: MECHANICAL EQU. ROOM
Length: 21' Width: 31' Height: 10.5'
Area: 651 ft² Mounting Height: 8'
% Wall: 30 % Ceiling: 50
Room Index: 3.2 UF: .34 MF: .65 UFxMF:
Req'd FC: 8 I.E.S. Maintained FC: 7.8

FC 8 × Sq. Ft. 651 / UF x MF .221 = Lumens 23566

Lumens 23566 / Lamp Lumens 2880 = Lamps 8.1

Fix's 8 × Lamps/F 1 × LL 2880 × UF x MF .221 / Sq. Ft. 651 = Maint. FC 7.8

Fixture Type: I.F. 150W Number of Fixtures: 8
Fixture Spacing: Number of Rows: Total Wattage: 1200 W
Remarks: CALCULATION OF EXISTING FC

Room Name: MECHANICAL EQU. ROOM
Length: 21' Width: 31' Height: 10.5'
Area: 651 ft² Mounting Height: 8'
% Wall: 30 % Ceiling: 50
Room Index: 3.2 UF: .58 MF: .65 UFxMF: .377
Req'd FC: 10 Maintained FC: 10.6

FC 10 × Sq. Ft. 651 / UF x MF .377 = Lumens

Lumens 17268 / Lamp Lumens 3050 = Lamps 5.66

Fix's 6 × Lamps/F 1 × LL 3050 × UF x MF .377 / Sq. Ft. 651 = Maint. FC 10.6

Fixture Type: LF40 STRIP WITH REFLECTOR Number of Fixtures: 6
Fixture Spacing: Number of Rows: Total Wattage:
Remarks: PROPOSED

Room Name:
Length: Width: Height:
Area: Mounting Height:
% Wall: % Ceiling:
Room Index: UF: MF: UFxMF:
Req'd FC: Maintained FC:

FC × Sq. Ft. / UF x MF = Lumens

Lumens / Lamp Lumens = Lamps

Fix's × Lamps/F × LL × UF x MF / Sq. Ft. = Maint. FC

Fixture Type: Number of Fixtures:
Fixture Spacing: Number of Rows: Total Wattage:
Remarks:

Room Name:
Length: Width: Height:
Area: Mounting Height:
% Wall: % Ceiling:
Room Index: UF: MF: UFxMF:
Req'd FC: Maintained FC:

FC × Sq. Ft. / UF x MF = Lumens

Lumens / Lamp Lumens = Lamps

Fix's × Lamps/F × LL × UF x MF / Sq. Ft. = Maint. FC

Fixture Type: Number of Fixtures:
Fixture Spacing: Number of Rows: Total Wattage:
Remarks:

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DESIGN ANALYSIS

- ☒ BUDGET
- ☐ PRELIMINARY
- ☐ FINAL
- ☐ OTHER

PROJECT NAME: EEA	PROJECT PART: A.P. HILL BLDG 921	SPEC. DIVISION:
DEPARTMENT: ELE.	COMPUTED BY: C. JA DATE: 1-29-82	JOB NO:
SHEET NO: OF:	CHECKED BY: DATE:	SHEET NO: OF:

LAVATORY (ABOVE BASIN) LIGHTS

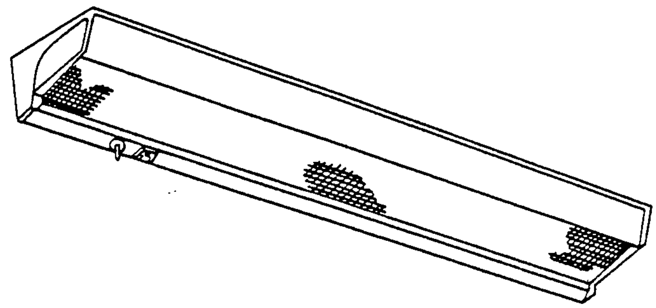
THERE EXISTS 10 ROWS OF 6 INCANDESCENT FIXTURES AND 2 ROWS OF 8 INCANDESCENT FIXTURES. EACH ROW IS 12 FEET LONG. EACH FIXTURE HAS ONE 100W LAMP. WHICH PROVIDES 1750 LUMENS.
TOTAL WATTAGE = 7600 W
THEREFORE, EXISTING LUMEN PER LINEAR FOOT IS,

$$\frac{(1750 \frac{\text{LUMENS}}{\text{FIXT.}})(6 \text{ FIXT})}{12 \text{ LINEAR FEET}} = 876 \text{ LUMENS/LINEAR FOOT}$$

REPLACE THE INCANDESCENT LIGHTING W/2 F34 WALL MOUNTED FIXTURES.

FM-084.0881/0100

2F34 WALL MOUNTED FIXTURES FOR USE IN BLG 821
Above Basin in LAVATORY.



TYPE 223
Two Lamps

Enclosed, Wall Mounted, Direct And/Or Indirect
Fluorescent Fixture

Fixture shall be constructed of cold-rolled steel and shall conform to UL 1570. Ferrous metal surfaces shall be treated with 5-stage coating of zinc phosphate and finished in baked white enamel. Seams shall be sealed or gasketed to prevent light leakage. The lens shall be 0.125 inch nominal thickness (minimum 0.115 inch) of 100 percent virgin clear acrylic plastic, with a regular array of prismatic elements on one surface and smooth on the other. Receptacle shall be 2-pole, 3-wire, rated at 15 amperes and 125 volts, and shall be of the grounding type. On/off pull chain switch shall be provided for downlight. Upward light shall be controlled from a wall switch. Fixture shall have knockouts in the back for wiring through an outlet box and a grounding terminal. Standard ballast shall be the Class P, high power factor type which has been approved for the application by the Certified Ballast Manufacturers. Fixture shall be prewired.

Fixture type indicated on this sheet shall also conform to requirements specified and indicated in the contract documents.

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DESIGN ANALYSIS

■ BUDGET
□ PRELIMINARY
□ FINAL
□ OTHER

PROJECT NAME: EFA	PROJECT PART: FORT HILL	SPEC. DIVISION: INEFFICIENT LIGHT FIXTURES
DEPARTMENT: ELECTRICAL	COMPUTED BY: CJA DATE: 5-7-82	JOB NO: 4417.02
SHEET NO: OF:	CHECKED BY: DATE:	SHEET NO: OF:

APPLICABLE BUILDINGS

GROUP B-2	GROUP C-2	GROUP D-2	GROUP E-1
# 253	# 1290	# 820	# 305
1526		1525	306
1528			821
1529			
1532			
1533			

FRJ066.Osd1/0109

Insulation of Domestic Water Heaters

LIFE CYCLE COST ANALYSIS SUMMARY
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)

LOCATION: Fort A.P. Hill, Virginia REGION: 3 PROJECT NO.: DACA 31-89-C-0198
PROJECT TITLE: Fort A.P. Hill- Energy Engineering Analysis Program FISCAL YEAR: 1994
DISCRETE PORTION NAME: Water Heater Insulation
ANALYSIS DATE: January 1994 ECONOMIC LIFE (YRS) 20 PREPARER: JJS

1. INVESTMENT COSTS:

A. CONSTRUCTION COST	$	26,765	
B. SIOH	$	1,472	
C. DESIGN COST	$	1,606	
D. TOTAL COST (1A+1B+1C)	$	29,843	
E. SALVAGE VALUE OF EXISTING EQUIPMENT			
F. PUBLIC UTILITY COMPANY REBATE			
G. TOTAL INVESTMENT (1D-1E-1F)			$29,843

2. ENERGY SAVINGS (+)/COST(-):

DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS- Oct 1992

ENERGY SOURCE	COST $/MBTU(1)	SAVING(S) MBTU/YR(2)		ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)		DISCOUNTED SAVINGS(5)
A. ELEC	$20.67	175.6	$	3,629	14.65	$	53,165
B. DIST	$5.69	329.7	$	1,876	17.70	$	33,205
C. RESID			$			$	
D. NG			$			$	
E. LPG	$7.76		$			$	
F. COAL			$			$	
G. SOLAR			$			$	
H. GEOTH			$			$	
I. BIOMA			$			$	
J. REFUS			$			$	
K. WIND			$			$	
L. OTHER			$			$	
M. DEMAND SAVINGS			$			$	
N. TOTAL		505	$	5,505		$	86,370

3. NON ENERGY SAVINGS (+) OR COST (-):

A. ANNUAL RECURRING (+/-)
(1) DISCOUNT FACTOR (TABLE A)
(2) DISCOUNTED SAVINGS/COST (3A X 3A1)

B. NON RECURRING SAVINGS (+) OR COST (-)

ITEM		SAVINGS(+) COST(-)(1)	YEAR OF OCCUR. (2)	DISCOUNT FACTOR(3)		DISCOUNTED SAV-INGS(+)COST(-)(4)
a.	$				$	
b.	$				$	
c.	$				$	
d. TOTAL					$	

C. TOTAL NON ENERGY DISCOUNTED SAVINGS (3A2+3Bd4)

4. SIMPLE PAYBACK 1G/(2N3+3A+(3Bd1/ECONOMIC LIFE)):	5.42 YEARS
5. TOTAL NET DISCOUNTED SAVINGS (2N5+3C):	$86,370
6. SAVINGS TO INVESTMENT RATION (SIR) 5/1G:	2.89
7. ADJUSTED INTERNAL RATE OF RETURN (AIRR):	5.68%

\Oproject\9200\ecip\WTRINS

CONSTRUCTION COST ESTIMATE	Date Prepared: 1/27/94	Reference: Means
Activity and Location: Energy Savings Opportunity Survey Fort A. P. Hill, Virginia	Constr. Contact No. DACA 31-89-C-0198 Estimated By: EAC, P.C.	I.D. No. Category Code
Project: Hot water heater insulation- Electric Tanks	Status: Final	Job Order No.

ITEM DESCRIPTION	QUANTITY		PRIME CONTRACTOR				SUBCONTRACTOR				TOTAL COST
			MATERIAL COST		LABOR COST		MATERIAL COST		LABOR COST		
	NUMBER	UNIT	UNIT COST	TOTAL	UNIT COST	TOTAL	UNIT COST	TOTAL	UNIT COST	TOTAL	
Insulation wrap kit- 1-1/2" thickness (20-80 Gallon)	150	EA	25.00	3,750	18.00	2,700					6,450
SUBTOTAL				$3,750		$2,700					$6,450

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CONSTRUCTION COST ESTIMATE	Date Prepared: 1/27/94	
Activity and Location: Energy Savings Opportunity Survey Fort A. P. Hill, Virginia	Constr. Contact No. DACA 31-89-C-0198	I.D. No.
	Estimated By: EAC, P.C.	Category Code
Project: Hot water heater insulation- Electric Tanks	Status: Final	Job Order No.

ITEM DESCRIPTION	QUANTITY		PRIME CONTRACTOR				SUBCONTRACTOR				TOTAL COST
			MATERIAL COST		LABOR COST		MATERIAL COST		LABOR COST		
SUMMARY	NUMBER	UNIT	UNIT COST	TOTAL	UNIT COST	TOTAL	UNIT COST	TOTAL	UNIT COST	TOTAL	
Subtotal				3,750		2,700					
DIRECT COSTS				3,750		2,700					
Design contingency			10.0%	375	10.0%	270	10.0%				
SUBTOTAL (DIRECT COSTS)				4,125		2,970					
Material Tax & Labor Taxes			5.0%	206	21.0%	624	5.0%		21.0%		
Overhead			15.0%	619	15.0%	446	15.0%		15.0%		
SUBTOTAL				4,950		4,039					
Profit			12.0%	594	12.0%	485	12.0%		12.0%		
SUBTOTAL				5,544		4,524					
Prime Overhead on Sub							5.0%		5.0%		
SUBTOTAL											
Prime Profit on Sub							5.0%		5.0%		
TOTAL				5,544		4,524					10,068

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CONSTRUCTION COST ESTIMATE	Date Prepared: 1/27/94	Reference: MMM Design 1982/ 1992 R.S. Means
Activity and Location: Energy Savings Opportunity Survey Fort A. P. Hill, Virginia	Constr. Contact No. DACA 31-89-C-0198 Estimated By: EAC, P.C.	I.D. No. Category Code
Project: Hot water heater insulation- Oil Fired	Status: Final	Job Order No.

ITEM DESCRIPTION	QUANTITY		PRIME CONTRACTOR				SUBCONTRACTOR				
			MATERIAL COST		LABOR COST		MATERIAL COST		LABOR COST		
	NUMBER	UNIT	UNIT COST	TOTAL	UNIT COST	TOTAL	UNIT COST	TOTAL	UNIT COST	TOTAL	TOTAL COST
Add 3" Tank Fiberglass to DHW (FRK 3" Thick, .75lb Density)	5,678	SF	0.59	3,350	1.41	8,006					11,356
SUBTOTAL				$3,350		$8,006					$11,356

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CONSTRUCTION COST ESTIMATE	Date Prepared: 1/27/94	
Activity and Location: Energy Savings Opportunity Survey Fort A. P. Hill, Virginia	Constr. Contact No. DACA 31-89-C-0198	I.D. No.
	Estimated By: EAC, P.C.	Category Code
Project: Hot water heater insulation- Oil Fired	Status: Final	Job Order No.

ITEM DESCRIPTION	QUANTITY		PRIME CONTRACTOR				SUBCONTRACTOR				TOTAL COST
			MATERIAL COST		LABOR COST		MATERIAL COST		LABOR COST		
SUMMARY	NUMBER	UNIT	UNIT COST	TOTAL	UNIT COST	TOTAL	UNIT COST	TOTAL	UNIT COST	TOTAL	
Subtotal				3,350		8,006					
DIRECT COSTS				3,350		8,006					
SUBTOTAL (DIRECT COSTS)				3,350		8,006					
Material Tax & Labor Taxes			5.0%	168	21.0%	1,681	5.0%		21.0%		
Overhead			15.0%	503	15.0%	1,201	15.0%		15.0%		
SUBTOTAL				4,020		10,888					
Profit			12.0%	482	12.0%	1,307	12.0%		12.0%		
SUBTOTAL				4,502		12,195					
Prime Overhead on Sub							5.0%		5.0%		
SUBTOTAL											
Prime Profit on Sub							5.0%		5.0%		
TOTAL COST				4,502		12,195					$16,697

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Water Heater Insulating Kits- Electric

Existing Conditions			Add Insulation Kits	
			4	Additional R Value
Heater Eff.=	100%		100%	
Tank Capacity	40	Gallons	40	Gallons
Utank=	0.22	Btu/F*Ft**2*Hr	0.11702	Btu/F*Ft**2*Hr
Atank=	27	Ft**2	30	Ft**2
Ttank=	120	F	120	F
Tsurroundings=	65	F	65	F
Operational Hours	8760		8760	
Part Time Load	4392		4392	

Year Round Savings

Existing Energy Usage	2,861,892.00	Btu/Yr
New Energy Usage w/Insulation	(1,691,425.53)	Btu/Yr
Savings	1.17	Mbtu/Yr
$ Savings	24	-

Seasonal Savings (April-October)

Existing Energy Usage	1,434,866.40	Btu/Yr
New Energy Usage w/Insulation	(848,029.79)	Btu/Yr
Savings	0.59	Mbtu/Yr
$ Savings	12	

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		MBtu/Yr	$/Yr
Number of Tanks	150	175.57	3,629

		Materials	Labor
Per Tank		25	18
Number of Tanks	150	3,750	2,700

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ENGINEERING ANALYSIS

Sheet ____ of ____

By: ____

WATER HEATER INSULATION KITS

Project: Fort A. P. Hill ESOS Date: 2-28-94

Contract No.: DACA 31-89-C-0198 EAC Project No.: 92008

Number of oil FIRED TANKS TAKEN FROM BUILDING SYSTEM PRINTOUT LIST. BUILDINGS with oil FIRED Boilers were assumed to have oil fired Hot water Storage Tanks for subgroups - QUARTERS AND Dinning as well as large (500 MAN) LATRINES.

OF ELECTRIC WATER HEATERS -
SUBTRACT oil FIRED heaters FROM TOTAL GROUP SQUARE FEET OF FLOOR AREA.

Housing - $476{,}974 - 348{,}541 = 128\,433 \text{ Ft}^2$

$$128{,}433 \text{ Ft}^2 \times \frac{1 \text{ TANK}}{1500 \text{ Ft}^2} = 107 \text{ TANKS (ELECTRIC)}$$

ADMIN - $$214{,}966 \times \frac{1 \text{ TANK}}{5000 \text{ Ft}^2} = 42 \text{ TANKS}$$

TOTAL ELECTRIC FIRED HOT WATER HEATERS $= 107 + 42 = 149$
$\cong$ 150 TANKS

BUILDING USE-GROUP	SUB-GROUP NO.	STUDY BUILDING NO.	WALL CODE	ROOF CODE	EN. SYS. CODE	TOTAL SUB-GROUP SQUARE FEET	TOTAL USE-GROUP SQUARE FEET
Administration	A-1	101/126/214	WD	PS	AB	138,136	
	A-2	none	VARIES	VARIES	B	76,830	214,966
Quarters	B-1	179/311	WD	PS	AB	127,281	
	B-2	1528	MAS	PS	AB	38,967	
	B-3	none	Varies	Varies	B	310,726	476,974
Shops	C-1	313	WD	PS	AB	38,394	
	C-2	1290	MAS	BU	AB	87,503	
	C-3	none	varies	varies	B	34,690	185,380
Latrines	E-1	821	MAS	BU	AB	19,573	
	E-2	none	varies	varies	B	13,961	33,534
Nonenergized	F-1	none	varies	varies	O	149,038	149,038
TOTAL BUILDING AREA							1,149,027

Wall Construction Code:
WD - Wood or metal frame with wook siding, metal siding or brick veneer.
MAS - Masonry block or brick.

Roof Construction Code:
PS - Pitched shingle over wood deck or metal roofing.
BU - Built-up roof over wood or metal deck.

Energized systems Code:
AB - Heating and non-heating systems.
B - Non-heating systems only.
O - No energized systems.

FORT A.P. HILL BUILDING USE-GROUP SUMMARY
FIGURE 1

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Study Building- 179
Floor Area 11,980 Ft**2

ECO	ECO Savings		Average Study Blg Savings		Average Study Blg Cost		Average Group Savings		Average Group Cost		No. of Units Per Study Bldg	Units per Study Blg Floor Area	Total Units Per Group
Study Blg 179	MBtu/Yr	$/Yr	MBtu/ft**2	$/Yr/ft**2	Materials $/ft**2	Labor $/ft**2	MBtu/Yr	$/Yr	Materials $	Labor $			
Insulate Water Tanks Seasonal Savings	8.47	48	0.0007	0.0040	0.008264	0.019616	246.4	1,401.8	2,880	6,837	1	8.35E-05	29

ECO	ECO Savings		Average Study Blg Savings		Average Study Blg Cost		Average Group Savings		Average Group Cost		No. of Units Per Study Bldg	Units per Study Blg Floor Area	Total Units Per Group
Study Blg 179	MBtu/Yr	$/Yr	MBtu/ft**2	$/Yr/ft**2	Materials $/ft**2	Labor $/ft**2	MBtu/Yr	$/Yr	Materials $	Labor $			
Insulate Water Tanks Year Round Savings	16.89	96	0.0014	0.0080	0.008264	0.019616	83.3	474.0	488	1,159	1	8.35E-05	5

Water Heater Insulating Kits- Oil Fired

Existing Conditions		Add Insulation Kits
		11 R-Value
Heater Eff.=	70%	70%
Tank Capacity	750 Gallons	750 Gallons
Utank=	0.15 Btu/F*Ft**2*Hr	0.0566 Btu/F*Ft**2*Hr
Atank=	138 Ft**2	167 Ft**2
Ttank=	180 F	180 F
Tsurroundings=	60 F	60 F
Operational Hours	8760	8760
Part Time Load	4392	4392

	Year Round Savings		
Existing Energy Usage		31,085,485.71	Btu/Yr
New Energy Usage w/Insulation		(14,195,450.13)	Btu/Yr
	Savings	16.89	Mbtu/Yr
	$ Savings	96	
	Seasonal Savings (April-October)		
Existing Energy Usage		15,585,325.71	Btu/Yr
New Energy Usage w/Insulation		(7,117,170.89)	Btu/Yr
	Savings	8.47	Mbtu/Yr
	$ Savings	48	

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Subgroup B-2- Seasonal Use Buildings

1526	7,563
1528	7,563
1529	7,563
1532	7,563
1533	7,563
	37,815

Subgroup B-3-Seasonal Use Buildings

1635	3,441
1636	3,441
1637	9,633
1638	9,633
1639	9,633
1640	9,633
1642	9,633
1643	9,633
1644	9,633
1645	9,633
1646	9,633
1647	9,633
1648	9,633
1649	3,441
1651	3,441
1652	9,633
1653	9,633
1655	3,441
1657	9,633
1658	9,633
1662	9,633
1663	9,633
1666	9,633
1667	9,633
1668	9,633
1669	9,633
1671	3,441
1680	3,441
1681	3,441
1682	3,441
1688	9,683
1689	9,683
1691	9,683
1692	9,683
1693	9,683
1695	9,683
1696	9,683
1694	9,683
	310,726

Subgroup D-2 Year Round Use

820	6,176
1525	12,000
	18,176

Subgroup D-3 Year Round Use

1641	11,070
1659	11,070
1690	11,070
	33,210

Subgroup E-1 Year Round Use

305	1,250
306	1,250
506	720
530	1,000
1320	1,240
1521	240
1522	1,000
1622	1,000
	7,700

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DESIGN ANALYSIS

☐ BUDGET
☐ PRELIMINARY
☐ FINAL
☐ OTHER

PROJECT NAME: EEAP - A P HILL	PROJECT PART: WATER HEATER INSULATION	SPEC. DIVISION: 40 GAL. ELECTRIC
DEPARTMENT: MECHANICAL	COMPUTED BY: CTW DATE: 3/14/83	JOB NO: 4417.02
SHEET NO: OF:	CHECKED BY: DATE:	SHEET NO: OF:

BASED ON THE STUDY BUILDING GROUP, ADMINISTRATIVE & SHOP BUILDINGS HAVE SMALL ELECTRIC WATER HEATERS, HOWEVER, SOME HEATERS ARE DE-ACTIVATED AND ADDITIONAL SHUT-DOWNS ARE RECOMMENDED.

TYP. 40 GAL. TANK, VERTICAL

APPROX. 18" ϕ x 5' HIGH $5 \times \pi \times (18-4)^2 \times 7.48/4 \times 144 = 40$ ✓

SURFACE AREA $= (\pi \times 18^2/4 \times 144) + (\pi \times 18 \times 5/12) = 25\ FT^2$

$R_1 \approx 4$

$U_1 = 1/(4+.68) = 0.21$ BTU/HR-FT²-F

ADD INSULATION KIT, 1½" TK. FIBERGLASS

AREA $= (\pi \times 21^2/4 \times 144) + (\pi \times 21 \times 5.1/12) = 30\ FT^2$

$U_2 = 1/(4+4+.68) = 0.11$

$\Delta U \times A \approx U_1 \times A_1 - U_2 \times A_2$ (NEGLECT CURVATURE)

$= (0.21 \times 25) - (0.11 \times 30) = 2.0$ BTU/HR-°F

YEAR-ROUND SAVINGS

TANK TEMP. = 120°F

AVG. OUTDOOR AIR TEMP. = 58°F, USE 60°F

SAVINGS $= (\Delta U \times A) \times \Delta T \times$ HRS

$= 2.0 \times (120-60) \times 365 \times 24 \times 11600/3413 = 3.6$ MBTU

$E/C = 3.6/(56.9/1000) = 62.8$ ✓

PAYBACK = 2.2 YRS

SEASONAL SAVINGS, APRIL → OCT

AVG. OUTDOOR AIR TEMP. ≈ 61°F, USE 63°F

SAVINGS $= 2.0 \times (120-63) \times 183 \times 24 \times 11600/3413 = 1.7$ MBTU

$E/C = 1.7/(56.9/1000) = 29.9$ ✓

PAY-BACK = 4.6 YRS

NOTE - LIFE CYCLE BENEFITS ARE DEPENDENT UPON REMAINING SERVICE LIFE OF WATER HEATER

FRM055. /0108

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DESIGN ANALYSIS

☐ PRELIMINARY
☐ FINAL
☐ OTHER

PROJECT NAME: EEAP – A P HILL	PROJECT PART: WATER HEATER INSULATION	SPEC. DIVISION: 750 GAL. OIL
DEPARTMENT: MECHANICAL	COMPUTED BY: CTW DATE: 3/14/83	JOB NO: 4417.02
SHEET NO: OF:	CHECKED BY: DATE:	SHEET NO: OF:

BASED ON STUDY BUILDINGS, OTHER BUILDINGS HAVE LARGE, OIL-FIRED WATER HEATERS. A LARGE PORTION OF THE BARRACKS HAVE NO DOMESTIC HOT WATER OR HAVE SMALL HEATERS, SINCE THEY ARE SERVICED BY CENTRAL LAVATORY FACILITIES. DINING FACILITIES REQUIRE HIGHER STORAGE TEMPERATURES FOR SANITARY DISHWASHING.

TYP. 750 GAL. STORAGE TANK, HORIZONTAL
APPROX. 5'ϕ x 6.3' LONG $\pi \times (5-0.5)^2 \times 6.3 \times 7.48/4 = 750$ ✓
$A_1 = (\pi \times 5^2/2) + (\pi \times 5 \times 6.3) = 138\ FT^2$
$R \approx 6$
$U_1 = 1/(6+.68) = 0.150$

ADD INSULATION, 3" TK. FIBERGLASS W/ VINYL JACKET (R-11)
$A_2 = (\pi \times 5.5^2/2) + (\pi \times 5.5 \times 6.9) = 167\ FT^2$
$U_2 = 1/(6+11+.68) = 0.057$
$\Delta U \times A = U_1 \times A_1 - U_2 \times A_2$ (NEGLECT CURVATURE)
$= 0.150 \times 138 - 0.057 \times 167 = 11.2$ BTU/HR-°F
SAVINGS = $\Delta U \times A \times \Delta T \times$ HRS $\times$ 1/0.70 (EFFICIENCY)

TANK TEMP	ITEM	YEAR-ROUND 8760 HRS	SEASONAL 4392 HRS
120°F	ΔT =	60	63
	MBT SAVED =	8.4	4.4
	E/C =	20.4 ✓	10.7
	PAY-BACK, YRS =	2.9	5.6
180°F	ΔT =	120	123
	MBTU SAVED =	16.8	8.6
	E/C =	40.7 ✓	20.9 ✓
	PAY-BACK, YRS =	1.5	2.8

NOTE – LIFE CYCLE BENEFITS ARE DEPENDENT UPON REMAINING SERVICE LIFE OF WATER HEATER.

FR4065 11/0108

Exit Sign Retrofit

LIFE CYCLE COST ANALYSIS SUMMARY
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)

LOCATION: Fort A.P. Hill, Virginia REGION: 3 PROJECT NO.: DACA 31-89-C-0198
PROJECT TITLE: Fort A.P. Hill- Energy Engineering Analysis Program FISCAL YEAR: 1994
DISCRETE PORTION NAME: Exit Sign Replacement
ANALYSIS DATE: January 1994 ECONOMIC LIFE (YRS 15 PREPARER: JJS

1. INVESTMENT COSTS:

A. CONSTRUCTION COST	$ 4,992		
B. SIOH	$ 275		
C. DESIGN COST	$ 300		
D. TOTAL COST (1A+1B+1C)	$ 5,566		
E. SALVAGE VALUE OF EXISTING EQUIPMENT			
F. PUBLIC UTILITY COMPANY REBATE			
G. TOTAL INVESTMENT (1D-1E-1F)			$5,566

2. ENERGY SAVINGS (+)/COST(-):

DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS- Oct 1992

ENERGY SOURCE	COST $/MBTU(1)	SAVING(S) MBTU/YR(2)	ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELEC	$20.67	31.0	$ 641	11.77	$ 7,542
B. DIST	$5.69		$		$
C. RESID			$		$
D. NG			$		$
E. LPG	$7.76		$		$
F. COAL			$		$
G. SOLAR			$		$
H. GEOTH			$		$
I. BIOMA			$		$
J. REFUS			$		$
K. WIND			$		$
L. OTHER			$		$
M. DEMAND SAVINGS			$		$
N. TOTAL		31	$ 641		$ 7,542

3. NON ENERGY SAVINGS (+) OR COST (-):

A. ANNUAL RECURRING (+/-)	$454		
(1) DISCOUNT FACTOR (TABLE A)		11.12	
(2) DISCOUNTED SAVINGS/COST (3A X 3A1)			$5,048

B. NON RECURRING SAVINGS (+) OR COST (-)

ITEM	SAVINGS(+) COST(-)(1)	YEAR OF OCCUR. (2)	DISCOUNT FACTOR(3)	DISCOUNTED SAVINGS(+)COST(-)(4)
a.	$			$
b.	$			$
c.	$			$
d. TOTAL				$

C. TOTAL NON ENERGY DISCOUNTED SAVINGS (3A2+3Bd4) $5,048

4. SIMPLE PAYBACK 1G/(2N3+3A+(3Bd1/ECONOMIC LIFE)): 5.08 YEARS
5. TOTAL NET DISCOUNTED SAVINGS (2N5+3C): $12,590
6. SAVINGS TO INVESTMENT RATION (SIR) 5/1G: 2.26
7. ADJUSTED INTERNAL RATE OF RETURN (AIRR): 5.82%

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ENGINEERING ANALYSIS

Sheet _____ of _____

By: JS

EXIT SIGN RETROFIT

Project: Fort A. P. Hill ESOS

Date: 2-28-94

Contract No.: DACA 31-89-C-0198

EAC Project No.: 92008

LAMP Economical life over 15 yrs

25W INCANDESCENT LAMP LIFE = 3000 hrs
(EXIT sign LAMPS GE p. 13)

6 WATT LED Life = 30 yrs ∴ USE 15 YRS (LIFE OF PROJECT)

$\frac{3000 \text{ hrs}}{8760 \text{ hrs/yr}} = .34$ YRS (USE 4 MOS. PER LAMP LIFE)

= 3 changes PER YR

48 LAMPS x $\frac{3 \text{ changes}}{\text{YR}} \times \frac{\$3.15}{\text{change}}$ = \$453.60 ≅ \$454

CONSTRUCTION COST ESTIMATE	PREPARED: March 1994	SHEET 1 OF 2
PROJECT: Energy Savings Oppurtunity Survey	CONTRACT NO.: DACA 31-89-C-0198	
LOCATION: Fort A.P. Hill, Virginia AE PROJECT NO.: 92008 AE: Engineering Applications Consultants, P.C.	ESTIMATOR: JS CHECKED BY: VP	PRELIM: FINAL: X

SUMMARY: Exit Sign Retrofit

ITEM	QUANTITY		MATERIAL		LABOR		TOTAL COST
	NO.	MEAS	UNIT	COST	UNIT	COST	
Battery Backup LED Exit Sign Replacement Fixtures							
SUBGROUP							
Administration Buildings	13	EA	125.00	1,625	25.00	325	1,950
Dinning Facilities	11	EA	125.00	1,375	25.00	275	1,650
Housing Facilities		EA	125.00		25.00		
SUB-TOTAL				3,000		600	3,600

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CONSTRUCTION COST ESTIMATE

PREPARED: March 1994 | SHEET 2 OF 2

PROJECT: Energy Savings Oppurtunity Survey

LOCATION: Fort A.P. Hill, Virginia
AE PROJECT NO.:
AE: Engineering Applications Consultants, P.C.

CONTRACT NO.: DACA 31-89-C-0198

ESTIMATOR: JS | PRELIM:
CHECKED BY: VP | FINAL: X

SUMMARY: Exit Sign Retrofit

ITEM	QUANTITY		MATERIAL		LABOR		TOTAL
	NO.	MEAS	UNIT	COST	UNIT	COST	COST
SUBTOTAL PREV. PAGE				3,000		600	3,600
MARK-UP ON LABOR SUB-TOTAL	21.0%			—		126	126 3,726
TAXES ON MATERIAL SUB-TOTAL	5.0%			150		—	150 3,876
OVERHEAD SUB-TOTAL	15.0%						581 4,457
PROFIT SUB-TOTAL	12.0%						535 4,992
PRIME MARK-UP ON SUB SUB-TOTAL							4,992
GRAND TOTAL							5,000

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Building Number	Dinning 172	Housing 174	Admin 1,253	Field Latrines 412
Floor Area (Ft**2)	4,272	4,800	5,000	143
Group Floor Area (Ft**2)	4,272	53,820	11,800	3,931

Existing Energy Usage- Bldg 1253	
MBtu/Yr	280.7
$/Yr	5,183

Existing Energy Usage- Bldg 174	
MBtu/Yr	378.7
$/Yr	6,992

Existing Energy Usage- Bldg 172	
MBtu/Yr	438.1
$/Yr	8,088

ECO	ECO Savings		Average Study Blg Savings		Average Study Blg Cost		Average Group Savings		Average Group Cost		No. of Units Per Study Bldg	Units per Study Blg Floor Area	Total Units Per Group
Subgroup A-1- Study Blg 1253	MBtu/Yr	$/Yr	MBtu/ft**2	$/Yr/ft**2	Materials $	Labor $	MBtu/Yr	$/Yr	Materials $	Labor $			
Low Flow Shower Heads	11.2	231	0.0031	0.0631	25	7	36.1	745	81	23	1	0.000273	3
Occupancy Sensors	31	573	0.0085	0.1566	616	56	99.9	1,847	1,986	181	8	0.002186	26
Compact Fluorescent Lights	6.93	127	0.0019	0.0347	192	4	22.3	409	619	13	8	0.002186	26
Energy Saving Fluorescent Lamps	22.8	420	0.0062	0.1148	497	216	73.5	1,354	1,602	696	144	0.039344	464
Exit Signs	5.38	150	0.0015	0.0410	500	100	17.3	484	1,612	322	4	0.001093	13
F32 T-8 Lighting System	39.7	733	0.0108	0.2003	2317	607	128.0	2,363	7,470	1,957	53	0.014481	171
Economizer Controls	24	444	0.0066	0.1213	2258	1280	77.4	1,431	7,280	4,127	1	0.000273	3
Daylight Dimming Controls	6.2	113	0.0017	0.0309	720	400	20.0	384	2,321	1,290	4	0.001093	13
Water Heater Timers	0.112	3	0.0000	0.0008	40	18	0.4	10	129	58	1	0.000273	3
Water Heater Insulation	1.17	24	0.0003	0.0066	25	18	3.8	77	81	58	1	0.000273	3

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ECO Subgroup B-1- Study Blg 174	ECO Savings MBtu/Yr	ECO Savings $/Yr	Average Study Blg Savings MBtu/ft**2	Average Study Blg Savings $/Yr/ft**2	Average Study Blg Cost Materials $/ft**2	Average Study Blg Cost Labor $/ft**2	Average Group Savings MBtu/Yr	Average Group Savings $/Yr	Average Group Cost Materials $	Average Group Cost Labor $	No. of Units Per Study Bldg	Units per Study Blg Floor Area	Total Units Per Group
Low Flow Shower Heads	37.2	769	0.0078	0.1602	150	42	417.1	8,622	1,682	471	6	0.00125	67
Compact Fluorescent Lighting	41.9	774	0.0087	0.1613	322	7	469.8	8,678	3,610	78	14	0.002917	157
Occupancy Sensors	55.4	1021	0.0115	0.2127	1078	98	621.2	11,448	12,087	1,099	14	0.002917	157
Water Heater Timer	1.13	23	0.0002	0.0048	40	18	12.7	258	449	202	1	0.000208	11
Energy Savings Fluorescent Lamps	19.6	361	0.0041	0.0752	490	213	219.8	4,048	5,494	2,388	142	0.029583	1,592
F32 T-8 Lighting System	12	221	0.0025	0.0460	2904	726	134.6	2,478	32,561	8,140	33	0.006875	370
Water Heater Insulation	1.17	24	0.0002	0.0050	25	18	13.1	269	280	202	1	0.000208	18

ECO Subgroup D-1- Study Blg 172	ECO Savings MBtu/Yr	ECO Savings $/Yr	Average Study Blg Savings MBtu/ft**2	Average Study Blg Savings $/Yr/ft**2	Average Study Blg Cost Materials $	Average Study Blg Cost Labor $	Average Group Savings MBtu/Yr	Average Group Savings $/Yr	Average Group Cost Materials $	Average Group Cost Labor $	No. of Units Per Study Bldg	Units per Study Blg Floor Area	Total Units Per Group
Compact Fluorescent Lights	4.12	76	0.0010	0.0178	142	3	4.1	76	142.00	3.00	6	0.001404	6
Energy Savings Fluorescent Lamps	3.68	68	0.0009	0.0159	131	57	3.7	68	131.00	57.00	38	0.008895	38
Occupancy Sensors	15.46	285	0.0036	0.0667	1213	284	15.5	285	1,213.00	284.00	15	0.003511	15
Exit Sign Retrofit	14.08	260	0.0033	0.0609	1375	275	14.1	260	1,375.00	275.00	11	0.002575	11
Water Heater Timers	0.5	9	0.0001	0.0021	40	18	0.5	9	40.00	18.00	1	0.000234	1
DayLight Dimming Controls	0.56	10	0.0001	0.0023	180	100	0.6	10	180.00	100.00	1	0.000234	1

ECO Subgroup E-2 Latrines	ECO Savings MBtu/Yr	ECO Savings $/Yr	Average Study Blg Savings MBtu/ft**2	Average Study Blg Savings $/Yr/ft**2	Average Study Blg Cost Materials $	Average Study Blg Cost Labor $	Average Group Savings MBtu/Yr	Average Group Savings $/Yr	Average Group Cost Materials $	Average Group Cost Labor $	No. of Units Per Study Bldg	Units per Study Blg Floor Area	Total Units Per Group
Compact Flourescent Lights	6.38	117	0.0446	0.8182	23	2	175.4	3,216	632.26	54.98	4	0.027972	119
Occupancy Sensors	2.12	40	0.0148	0.2797	154	14	58.3	1,100	4,233.38	384.85	2	0.013986	60

New Buildings List- Buildings built after 1985 Fort A.P. Hill

SUBGROUP A-1

Bldg. No	Description	Floor Area (Ft**2)
1247	Entomology Facility	1,800
1252	General Inst. Bldg	5,000
1253	Range Control Bldg	5,000
	TOTAL	11,800

SUBGROUP B-1

Bldg. No	Description	Floor Area (Ft**2)
174	Guest House	4,800
290	Log Cabin Bullocks Lake	1,056
1350	FH NCO & ENL, QTRS 8	7,256
1351	FH NCO & ENL, QTRS 6	7,256
1352	FH NCO & ENL, QTRS 4	7,256
1353	FH NCO & ENL, QTRS 2	3,804
1354	FH Colonel, QTRS 1	2,553
1355	CO Grade & WO, QTRS 3	4,846
1356	FH NCO & ENL, QTRS 5	7,737
1357	FH NCO & ENL, QTRS 7	7,256
	TOTAL	53,820

SUBGROUP D-1

Bldg. No	Description	Floor Area (Ft**2)
172	Open Dinning NCO	4,272
	TOTAL	4,272

SUBGROUP E-1

Bldg. No	Description	Floor Area (Ft**2)
1241	Detached Latrine/Shwr	533

SUBGROUP E-2

Bldg. No	Description	Floor Area (Ft**2)
412	Detached Latrine TA12	143
413	Detached Latrine TA12	143
529	Detached Latrine Area 15	90
531	Detached Latrine TA15	143
733	Detached Latrine TNG 18	90
745	Detached Latrine TNG 14	144
746	Detached Latrine Rapp. Compound	144
748	Detached Latrine TA 18	143
826	Detached Latrine Range 42	143
828	Detached Latrine TNG 28	144
839	Detached Latrine at Repell. Twr	143
924	Detached Latrine	108
928	Detached Latrine	144
1008	Detached Latrine- Range 25	143
1024	Detached Latrine-Range 24	144
1108	Detached Latrine-Range 28P	144
1109	Detached Latrine-Range 28P	144
1110	Detached Latrine-Range 28P	144
1114	Detached Latrine	144
1116	Detached Latrine-Range 33	143
1202	Detached Latrine- Range 7	143
1254	Detached Latrine-Range 37	143
1256	Detached Latrine	108
1263	Detached Latrine-Range 6	143
1403	Detached Latrine-Tr Area 5	90
1405	Detached Latrine-Tr Area 3	90
1428	Detached Latrine-Tr Area 3	144
1619	Detached Latrine-Tr Area 21	90
1670	Detached Latrine-Tr Area 21	144
S 1272	Detached Latrine- Range 33	108
	TOTAL	3,931

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Replace Exiting Fluorescent Fixtures with Energy Effiecient Fixtures, Ballast and Lamps

LIFE CYCLE COST ANALYSIS SUMMARY
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)

LOCATION: Fort A.P. Hill, Virginia REGION: 3 PROJECT NO.: DACA 31-89-C-0198
PROJECT TITLE: Fort A.P. Hill- Energy Engineering Analysis Program FISCAL YEAR: 1994
DISCRETE PORTION NAME: Replace Existing Fluorescent Fixtures with Energy Efficient Fixtures, Ballast and Lamps
ANALYSIS DATE: January 1994 ECONOMIC LIFE (YRS 15 PREPARER: JJS

1. INVESTMENT COSTS:

A. CONSTRUCTION COST	$	14,912	
B. SIOH	$	820	
C. DESIGN COST	$	895	
D. TOTAL COST (1A+1B+1C)	$	16,627	
E. SALVAGE VALUE OF EXISTING EQUIPMENT			
F. PUBLIC UTILITY COMPANY REBATE			
G. TOTAL INVESTMENT (1D-1E-1F)			$16,627

2. ENERGY SAVINGS (+)/COST(-):

DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS- Oct 1992

ENERGY SOURCE	COST $/MBTU(1)	SAVING(S) MBTU/YR(2)	ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELEC	$20.67	128.0	$ 2,646	11.77	$ 31,141
B. DIST	$5.69		$		$
C. RESID			$		$
D. NG			$		$
E. LPG	$7.76		$		$
F. COAL			$		$
G. SOLAR			$		$
H. GEOTH			$		$
I. BIOMA			$		$
J. REFUS			$		$
K. WIND			$		$
L. OTHER			$		$
M. DEMAND SAVINGS			$		$
N. TOTAL		128	$ 2,646		$ 31,141

3. NON ENERGY SAVINGS (+) OR COST (-):

A. ANNUAL RECURRING (+/-)
(1) DISCOUNT FACTOR (TABLE A)
(2) DISCOUNTED SAVINGS/COST (3A X 3A1)

B. NON RECURRING SAVINGS (+) OR COST (-)

ITEM	SAVINGS(+) COST(-)(1)	YEAR OF OCCUR. (2)	DISCOUNT FACTOR(3)	DISCOUNTED SAV-INGS(+)COST(-)(4)
a.	$			$
b.	$			$
c.	$			$
d. TOTAL				$

C. TOTAL NON ENERGY DISCOUNTED SAVINGS (3A2+3Bd4)

4. SIMPLE PAYBACK 1G/(2N3+3A+(3Bd1/ECONOMIC LIFE)):	6.28 YEARS
5. TOTAL NET DISCOUNTED SAVINGS (2N5+3C):	$31,141
6. SAVINGS TO INVESTMENT RATION (SIR) 5/1G:	1.87
7. ADJUSTED INTERNAL RATE OF RETURN (AIRR):	4.44%

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CONSTRUCTION COST ESTIMATE	PREPARED: March 1994	SHEET 1 OF 2
PROJECT: Energy Savings Oppurtunity Survey	CONTRACT NO.: DACA 31-89-C-0198	
LOCATION: Fort A.P. Hill, Virginia		
AE PROJECT NO.: 92008	ESTIMATOR: JS	PRELIM:
AE: Engineering Applications Consultants, P.C.	CHECKED BY: VP	FINAL: X

SUMMARY: Replace Existing Fluorescent Fixtures with Energy Efficient Fixtures, Ballast, and Lamps

ITEM	QUANTITY		MATERIAL		LABOR		TOTAL
	NO.	MEAS	UNIT	COST	UNIT	COST	COST
F32T-8 Lighting Retrofit							
SUBGROUP							
Administration Buildings							
F32T-8 Lamps	1	Group	8,430.00	8,430	2,253.00	2,253	10,683
SUB-TOTAL				8,430		2,253	10,683

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CONSTRUCTION COST ESTIMATE

PREPARED: March 1994 SHEET OF

PROJECT: Energy Savings Oppurtunity Survey

SHEET 2 OF 2

CONTRACT NO.: DACA 31-89-C-0198

LOCATION: Fort A.P. Hill, Virginia

AE PROJECT NO.:

ESTIMATOR: JS PRELIM:

AE: Engineering Applications Consultants, P.C.

CHECKED BY: VP FINAL: X

SUMMARY: Replace Existing Fluorescent Fixtures with Energy Efficient Fixtures, Ballast, and Lamps

ITEM	QUANTITY		MATERIAL		LABOR		TOTAL COST
	NO.	MEAS	UNIT	COST	UNIT	COST	
SUBTOTAL PREV. PAGE				8,430		2,253	10,683
MARK-UP ON LABOR SUB-TOTAL	21.0%			—		473	473 11,156
TAXES ON MATERIAL SUB-TOTAL	5.0%			422		—	422 11,578
OVERHEAD SUB-TOTAL	15.0%						1,737 13,314
PROFIT SUB-TOTAL	12.0%						1,598 14,912
PRIME MARK-UP ON SUB SUB-TOTAL							14,912
GRAND TOTAL							14,900

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	Dinning	Housing	Admin	Field Latrines
Building Number	172	174	1,253	412
Floor Area (Ft**2)	4,272	4,800	5,000	143
Group Floor Area (Ft**2)	4,272	53,820	11,800	3,931

Existing Energy Usage- Bldg 1253	
MBtu/Yr	280.7
$/Yr	5,183
Existing Energy Usage- Bldg 174	
MBtu/Yr	378.7
$/Yr	6,992
Existing Energy Usage- Bldg 172	
MBtu/Yr	438.1
$/Yr	8,088

ECO	ECO Savings		Average Study Blg Savings		Average Study Blg Cost		Average Group Savings		Average Group Cost		No. of Units Per Study Bldg	Units per Study Blg Floor Area	Total Units Per Group
Subgroup A-1- Study Blg 1253	MBtu/Yr	$/Yr	MBtu/ft**2	$/Yr/ft**2	Materials $	Labor $	MBtu/Yr	$/Yr	Materials $	Labor $			
Low Flow Shower Heads	11.2	231	0.0031	0.0631	25	7	36.1	745	81	23	1	0.000273	3
Occupancy Sensors	31	573	0.0085	0.1566	616	56	99.9	1,847	1,986	181	8	0.002186	26
Compact Fluorescent Lights	6.93	127	0.0019	0.0347	192	4	22.3	409	619	13	8	0.002186	26
Energy Saving Fluorescent Lamps	22.8	420	0.0062	0.1148	497	216	73.5	1,354	1,602	696	144	0.039344	464
Exit Signs	5.38	150	0.0015	0.0410	500	100	17.3	484	1,612	322	4	0.001093	13
F32 T-8 Lighting System	39.7	733	0.0108	0.2003	2317	607	128.0	2,363	7,470	1,957	53	0.014481	171
Economizer Controls	24	444	0.0066	0.1213	2258	1280	77.4	1,431	7,280	4,127	1	0.000273	3
Daylight Dimming Controls	6.2	113	0.0017	0.0309	720	400	20.0	364	2,321	1,290	4	0.001093	13
Water Heater Timers	0.112	3	0.0000	0.0008	40	18	0.4	10	129	58	1	0.000273	3
Water Heater Insulation	1.17	24	0.0003	0.0066	25	18	3.8	77	81	58	1	0.000273	3

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ECO	ECO Savings		Average Study Blg Savings		Average Study Blg Cost		Average Group Savings		Average Group Cost		No. of Units Per Study Bldg	Units per Study Blg Floor Area	Total Units Per Group
Subgroup B-1- Study Blg 174	MBtu/Yr	$/Yr	MBtu/ft**2	$/Yr/ft**2	Materials $/ft**2	Labor $/ft**2	MBtu/Yr	$/Yr	Materials $	Labor $			
Low Flow Shower Heads	37.2	769	0.0078	0.1602	150	42	417.1	8,622	1,682	471	6	0.00125	67
Compact Fluorescent Lighting	41.9	774	0.0087	0.1613	322	7	469.8	8,678	3,610	78	14	0.002917	157
Occupancy Sensors	55.4	1021	0.0115	0.2127	1078	98	621.2	11,446	12,087	1,099	14	0.002917	157
Water Heater Timer	1.13	23	0.0002	0.0048	40	18	12.7	258	449	202	1	0.000208	11
Energy Savings Fluorescent Lamps	19.6	361	0.0041	0.0752	490	213	219.8	4,048	5,494	2,388	142	0.029583	1,592
F32 T-8 Lighting System	12	221	0.0025	0.0460	2904	726	134.6	2,478	32,561	8,140	33	0.006875	370
Water Heater Insulation	1.17	24	0.0002	0.0050	25	18	13.1	269	280	202	1	0.000208	18

ECO	ECO Savings		Average Study Blg Savings		Average Study Blg Cost		Average Group Savings		Average Group Cost		No. of Units Per Study Bldg	Units per Study Blg Floor Area	Total Units Per Group
Subgroup D-1- Study Blg 172	MBtu/Yr	$/Yr	MBtu/ft**2	$/Yr/ft**2	Materials $	Labor $	MBtu/Yr	$/Yr	Materials $	Labor $			
Compact Fluorescent Lights	4.12	76	0.0010	0.0178	142	3	4.1	76	142.00	3.00	6	0.001404	6
Energy Savings Fluorescent Lamps	3.68	68	0.0009	0.0159	131	57	3.7	68	131.00	57.00	38	0.008895	38
Occupancy Sensors	15.46	285	0.0036	0.0667	1213	284	15.5	285	1,213.00	284.00	15	0.003511	15
Exit Sign Retrofit	14.08	260	0.0033	0.0609	1375	275	14.1	260	1,375.00	275.00	11	0.002575	11
Water Heater Timers	0.5	9	0.0001	0.0021	40	18	0.5	9	40.00	18.00	1	0.000234	1
DayLight Dimming Controls	0.56	10	0.0001	0.0023	180	100	0.6	10	180.00	100.00	1	0.000234	1

ECO	ECO Savings		Average Study Blg Savings		Average Study Blg Cost		Average Group Savings		Average Group Cost		No. of Units Per Study Bldg	Units per Study Blg Floor Area	Total Units Per Group
Subgroup E-2 Latrines	MBtu/Yr	$/Yr	MBtu/ft**2	$/Yr/ft**2	Materials $	Labor $	MBtu/Yr	$/Yr	Materials $	Labor $			
Compact Flourescent Lights	6.38	117	0.0446	0.8182	23	2	175.4	3,216	632.26	54.98	4	0.027972	119
Occupancy Sensors	2.12	40	0.0148	0.2797	154	14	58.3	1,100	4,233.38	384.85	2	0.013986	60

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New Buildings List- Buildings built after 1985 Fort A.P. Hill

SUBGROUP A-1

Bldg. No	Description		Floor Area (Ft**2)
1247	Entomology Facility		1,800
1252	General Inst. Bldg		5,000
1253	Range Control Bldg		5,000
		TOTAL	11,800

SUBGROUP B-1

Bldg. No	Description		Floor Area (Ft**2)
174	Guest House		4,800
290	Log Cabin Bullocks Lake		1,056
1350	FH NCO & ENL, QTRS 8		7,256
1351	FH NCO & ENL, QTRS 6		7,256
1352	FH NCO & ENL, QTRS 4		7,256
1353	FH NCO & ENL, QTRS 2		3,804
1354	FH Colonel, QTRS 1		2,553
1355	CO Grade & WO, QTRS 3		4,846
1356	FH NCO & ENL, QTRS 5		7,737
1357	FH NCO & ENL, QTRS 7		7,256
		TOTAL	53,820

SUBGROUP D-1

Bldg. No	Description		Floor Area (Ft**2)
172	Open Dinning NCO		4,272
		TOTAL	4,272

SUBGROUP E-1

Bldg. No	Description		Floor Area (Ft**2)
1241	Detached Latrine/Shwr		533

SUBGROUP E-2

Bldg. No	Description		Floor Area (Ft**2)
412	Detached Latrine TA12		143
413	Detached Latrine TA12		143
529	Detached Latrine Area 15		90
531	Detached Latrine TA15		143
733	Detached Latrine TNG 18		90
745	Detached Latrine TNG 14		144
746	Detached Latrine Rapp. Compound		144
748	Detached Latrine TA 18		143
826	Detached Latrine Range 42		143
828	Detached Latrine TNG 28		144
839	Detached Latrine at Repell. Twr		143
924	Detached Latrine		108
928	Detached Latrine		144
1008	Detached Latrine- Range 25		143
1024	Detached Latrine-Range 24		144
1108	Detached Latrine-Range 28P		144
1109	Detached Latrine-Range 28P		144
1110	Detached Latrine-Range 28P		144
1114	Detached Latrine		144
1116	Detached Latrine-Range 33		143
1202	Detached Latrine- Range 7		143
1254	Detached Latrine-Range 37		143
1256	Detached Latrine		108
1263	Detached Latrine-Range 6		143
1403	Detached Latrine-Tr Area 5		90
1405	Detached Latrine-Tr Area 3		90
1428	Detached Latrine-Tr Area 3		144
1619	Detached Latrine-Tr Area 21		90
1670	Detached Latrine-Tr Area 21		144
S 1272	Detached Latrine- Range 33		108
		TOTAL	3,931

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Ceiling Insulation

LIFE CYCLE COST ANALYSIS SUMMARY
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)

LOCATION: Fort A.P. Hill, Virginia REGION: 3 PROJECT NO.: DACA 31-89-C-0198
PROJECT TITLE: Fort A.P. Hill- Energy Engineering Analysis Program FISCAL YEAR: 1994
DISCRETE PORTION NAME: Ceiling Insulation
ANALYSIS DATE: January 1994 ECONOMIC LIFE (YRS) 20 PREPARER: JJS

1. INVESTMENT COSTS:

A. CONSTRUCTION COST	$	125,160	
B. SIOH	$	6,884	
C. DESIGN COST	$	7,510	
D. TOTAL COST (1A+1B+1C)	$	139,553	
E. SALVAGE VALUE OF EXISTING EQUIPMENT			
F. PUBLIC UTILITY COMPANY REBATE			
G. TOTAL INVESTMENT (1D-1E-1F)			$139,553

2. ENERGY SAVINGS (+)/COST(-):

DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS- Oct 1992

ENERGY SOURCE	COST $/MBTU(1)	SAVING(S) MBTU/YR(2)		ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)		DISCOUNTED SAVINGS(5)
A. ELEC	$20.67	10.7	$	221	14.65	$	3,240
B. DIST	$5.69	2,340.9	$	13,320	17.70	$	235,759
C. RESID			$			$	
D. NG			$			$	
E. LPG	$7.76		$			$	
F. COAL			$			$	
G. SOLAR			$			$	
H. GEOTH			$			$	
I. BIOMA			$			$	
J. REFUS			$			$	
K. WIND			$			$	
L. OTHER			$			$	
M. DEMAND SAVINGS			$			$	
N. TOTAL		2,352	$	13,541		$	238,999

3. NON ENERGY SAVINGS (+) OR COST (-):

A. ANNUAL RECURRING (+/-)
(1) DISCOUNT FACTOR (TABLE A)
(2) DISCOUNTED SAVINGS/COST (3A X 3A1)

B. NON RECURRING SAVINGS (+) OR COST (-)

ITEM		SAVINGS(+) COST(-)(1)	YEAR OF OCCUR. (2)	DISCOUNT FACTOR(3)		DISCOUNTED SAVINGS(+)COST(-)(4)
a.	$				$	
b.	$				$	
c.	$				$	
d. TOTAL					$	

C. TOTAL NON ENERGY DISCOUNTED SAVINGS (3A2+3Bd4)

4. SIMPLE PAYBACK 1G/(2N3+3A+(3Bd1/ECONOMIC LIFE)):	10 YEARS
5. TOTAL NET DISCOUNTED SAVINGS (2N5+3C):	$238,999
6. SAVINGS TO INVESTMENT RATION (SIR) 5/1G:	1.71
7. ADJUSTED INTERNAL RATE OF RETURN (AIRR):	2.84%

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CONSTRUCTION COST ESTIMATE	Date Prepared: 1/27/94	
Activity and Location: Energy Savings Opportunity Survey Fort A. P. Hill, Virginia	Constr. Contact No. DACA 31-89-C-0198	I.D. No.
	Estimated By: EAC, P.C.	Category Code
Project: Ceiling Insulation	Status: Final	Job Order No.

ITEM DESCRIPTION	QUANTITY		PRIME CONTRACTOR				SUBCONTRACTOR				TOTAL COST
			MATERIAL COST		LABOR COST		MATERIAL COST		LABOR COST		
SUMMARY	NUMBER	UNIT	UNIT COST	TOTAL	UNIT COST	TOTAL	UNIT COST	TOTAL	UNIT COST	TOTAL	
Subtotal				49,950		38,095					
DIRECT COSTS				49,950		38,095					
SUBTOTAL (DIRECT COSTS)				49,950		38,095					
Material Tax & Labor Taxes			5.0%	2,498	21.0%	8,000	5.0%		21.0%		
Overhead			15.0%	7,493	15.0%	5,714	15.0%		15.0%		
SUBTOTAL				59,940		51,810					
Profit			12.0%	7,193	12.0%	6,217	12.0%		12.0%		
SUBTOTAL				67,133		58,027					
Prime Overhead on Sub							5.0%		5.0%		
SUBTOTAL											
Prime Profit on Sub							5.0%		5.0%		
TOTAL COST				67,133		58,027					125,160

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CONSTRUCTION COST ESTIMATE	Date Prepared: 1/27/94	Reference: MMM Design Group 1982/ R.S. Means 1992
Activity and Location: Energy Savings Opportunity Survey Fort A. P. Hill, Virginia	Constr. Contact No. DACA 31-89-C-0198	I.D. No.
	Estimated By: EAC, P.C.	Category Code
Project: Ceiling Insulation	Status: Final	Job Order No.

ITEM DESCRIPTION	QUANTITY		PRIME CONTRACTOR				SUBCONTRACTOR				
			MATERIAL COST		LABOR COST		MATERIAL COST		LABOR COST		
	NUMBER	UNIT	UNIT COST	TOTAL	UNIT COST	TOTAL	UNIT COST	TOTAL	UNIT COST	TOTAL	TOTAL COST
GROUP A-1	73,043	SF	0.214	15,646	0.164	11,964					27,610
GROUP A-1 (WINTERIZED)	9,565	SF	0.214	2,049	0.164	1,567					3,616
GROUP B-1	33,501	SF	0.214	7,176	0.164	5,487					12,663
GROUP B-1 (WINTERIZED)	2,740	SF	0.214	587	0.164	449					1,036
GROUP B-2	36,663	SF	0.214	7,853	0.164	6,005					13,859
GROUP C-1	24,226	SF	0.214	5,189	0.164	3,968					9,157
GROUP C-1 (WINTERIZED)	260	SF	0.214	56	0.164	43					98
GROUP C-2	3,315	SF	0.214	710	0.133	441					1,151
GROUP D-1	22,222	SF	0.214	4,760	0.164	3,640					8,400
GROUP D-1 (WINTERIZED)											
GROUP D-2	18,176	SF	0.214	3,893	0.164	2,977					6,871
GROUP E-1	9,484	SF	0.214	2,031	0.164	1,553					3,585
GROUP E-1 (WINTERIZED)											
SUB - TOTAL				$49,950		$38,095					$88,046

Oproject\92008\cost\ceilins

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136

A PROFESSIONAL CORPORATION
ARCHITECTS • ENGINEERS • PLANNERS

ANALYSIS

☐ FINAL
☐ OTHER

PROJECT NAME: FORT A.P. HILL E.E.A.	PROJECT PART: CEILING INSULATION	SPEC. DIVISION: COST ESTIMATE
DEPARTMENT: Architectural	COMPUTED BY: CTW DATE: 9/27/82	JOB NO: 4417.02
SHEET NO: OF:	CHECKED BY: DATE:	SHEET NO: OF:

A	B	C	D	E=D÷C	F	G=ExF
SUB GROUP	BUILDING NUMBER	FLOOR AREA - S.F.	PROJECT AREA - FT^2	RATIO	UNIT COST	COST PER F OF FLOOR ARE.
A-1	101	5080	5080	1.00	(SEE COST ESTIMATE SHEETS)	G=E×F TYPICAL
A-1	126	2490	2490	1.00		
B-1	311	3247	3247	1.00		
B-2	1528	7563	7563	1.00		
C-1	313	5171	5171	1.00		
C-2	1290	9306	9306	1.00		
D-1	179	6275	6275	1.00		
D-2	820	6176	6176	1.00		
E-1	821	5984	5984	1.00		

Engineering
Applications
Consultants

A Professional
Corporation

9004-B Crownwood Ct.
Burke, Virginia 22015-1630
(703) 978-0923

ENGINEERING ANALYSIS

Sheet ____ of ____

By: JS

Ceiling Insulation

Project: Fort A. P. Hill ESOS   Date: 2-28-94

Contract No.: DACA 31-89-C-0198   EAC Project No.: 92008

	M	L
Kraft Faced Batt Insulation (R-19)	0.39	0.133
Mineral Fiber Blown Insulation (R-19) (Includes Cutting & Patching)	0.204	0.119
4 mil Polyethylene Vapor Barrier	0.010	0.045

BUILDING GROUP ENERGY SAVINGS
CEILING/ATTIC INSULATION

SUB GROUP	STUDY BUILDING	APPLIED GROUP (SQ-FT)	AVERAGE SUB-GROUP SAVINGS BTU/FT^2-YR			TOTAL SUB-GROUP SAVINGS MBTU/YR		
			ELECTRIC	FUEL	TOTAL	ELECTRIC	FUEL	TOTAL
A-1	101,126	73,043	-139	23,830	23,691	-10.1	1,741.1	1,731.0
A-1W	101,126	9,565	-530	4,952	4,442	-5.1	47.4	42.3
B-1	311	33,501	-	2,342	2,342	-	78.4	78.4
B-1W	311	2,740	-	370	370	-	1.0	1.0
B-2	1528	36,663	-	2,354	2,354	-	89.0	89.0
C-1	313	24,226	39	2,561	2,600	1.1	62.0	63.1
C-1W	313	260	-	172	172	-	0	0
C-2	313	3,315	39	2,561	2,600	0.1	8.5	8.6
D-1	820	22,222	566	7,141	7,707	12.5	158.6	171.1
D-2	820	18,176	566	7,141	7,707	10.3	129.8	140.1
E-1	821	9,484	199	2,650	0	1.9	25.1	27.0
TOTAL ENERGY SAVINGS						10.7	2,340.9	2,351.6

BUILDING GROUP ENERGY USAGE

CEILING INSULATION ONLY

SUB GROUP	STUDY BUILDING	AVERAGE SUB - GROUP BASIC BTU/FT² - YR.			AVERAGE SUB - GROUP WITH OPTION BTU/FT² - YR.		
		ELECTRIC	FUEL	TOTAL	ELECTRIC	FUEL	TOTAL
A-1	101,126	83040	119426	202466	83179	95596	178775
A-1W	101,126	49238	17775	67013	49768	12823	62591
B-1	311	22298	90360	112658	22298	87988	110286
B-1W	311	10471	9055	19526	10471	8685	19156
B-2	1528	62964	123417	186381	62964	121063	184027
C-1	313	70902	89282	160184	70863	86721	157584
C-1W	313	37791	6057	43848	37791	5885	43676
C-2	SEE C-1						
D-1	SEE D-2						
D-2	820	142940	468524	611464	142374	461383	603756
E-1	821	412543	245961	658504	412344	243311	655655

W = WINTERIZED

EEA018-0582/0103

MMM DESIGN GROUP
A PROFESSIONAL CORPORATION
ARCHITECTS • ENGINEERS • PLANNERS

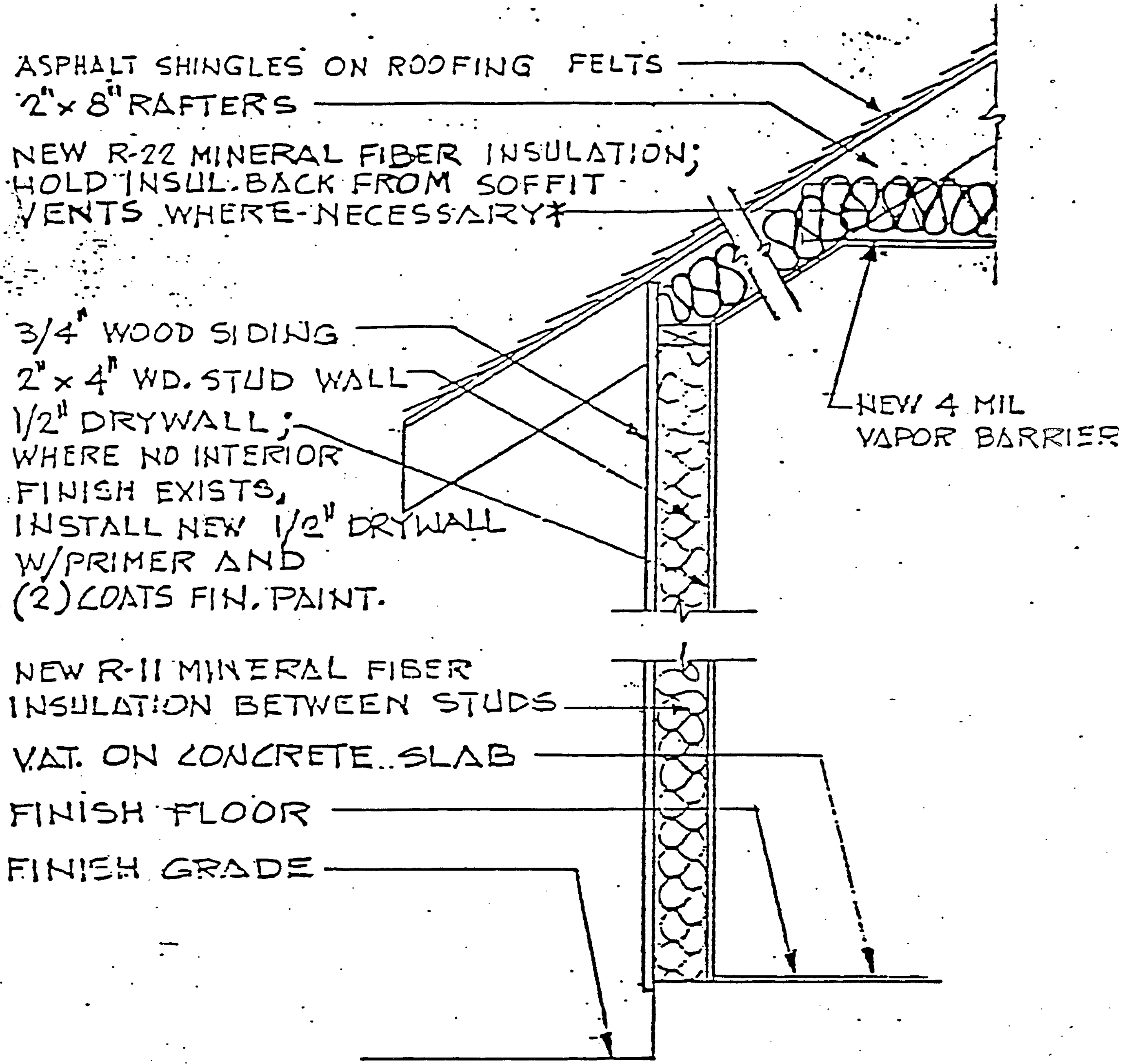
DESIGN ANALYSIS

- [x] BUDGET
- [ ] PRELIMINARY
- [ ] FINAL
- [ ] OTHER

PROJECT NAME: EEAP - A.P. HILL	PROJECT PART: CEILING INSULATION	SPEC. DIVISION:
DEPARTMENT: MECHANICAL	COMPUTED BY: CTW DATE: 9/24/82	JOB NO: 4417.02
SHEET NO: OF:	CHECKED BY: DATE:	SHEET NO: OF:

CEILING / ATTIC INSULATION
INVOLVED BUILDINGS:

102	158	322	352	1201
103		323	353	1206
104		324	354	1213
105		325	356	1214
		326	357	1220
109		327	358	1221
113	214	328	359	1222
115		329	360	
116		330	361	1225
120		331	361	
121	219	332	362	1227
122	220	333	363	1231
123	224	334	364	1262
		335	501	1282
	227	336	506	1291
	250	337	705	1301
		338	707	1401
129	258	339	708	1501
		~~340~~	803	1535 ~~1525~~
135	304	341	808	1526
136	305	342	811	1527
	306	343	812	1528
139		344	813	1529
140	309	345	814	1532
	310	346	815	1533
144	311	347	816	1601
145	312	348	817	1622
148	~~313~~	349	818	2001
149	320	350	820	9071
151	321	351	821	801



TYPICAL CEILING INSULATION INSTALLATION

* APPLIES TO BUILDINGS WITH ENCLOSED ATTIC SPACE.

APPENDIX F- PRODUCT INFORMATION

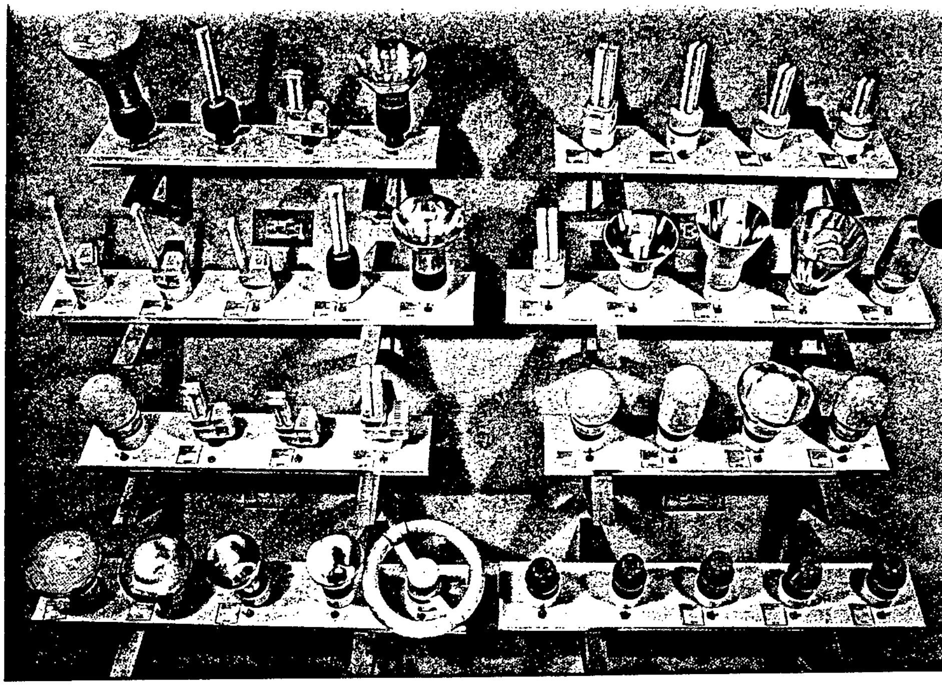
LOW FLOW SHOWER HEADS

Low flow shower heads reduce the amount of hot water consumed during showers. A typical shower head flow can be as high as 7 Gallons Per Minute (GPM). Low flow shower heads have a flow rate of 2 to 3 GPM. These shower heads not only reduce the hot water energy but also conserve water usage.

The Criteria used for study purposes are: The existing shower heads have a flow of about 5 to 6 gpm. The cost for materials is about $32 per shower head for labor and materials. The actual cost and savings will vary depending on the quantity purchased and the procurement method used. Enclosed is some product literature. Additional information and prices may be obtained from the following companies:

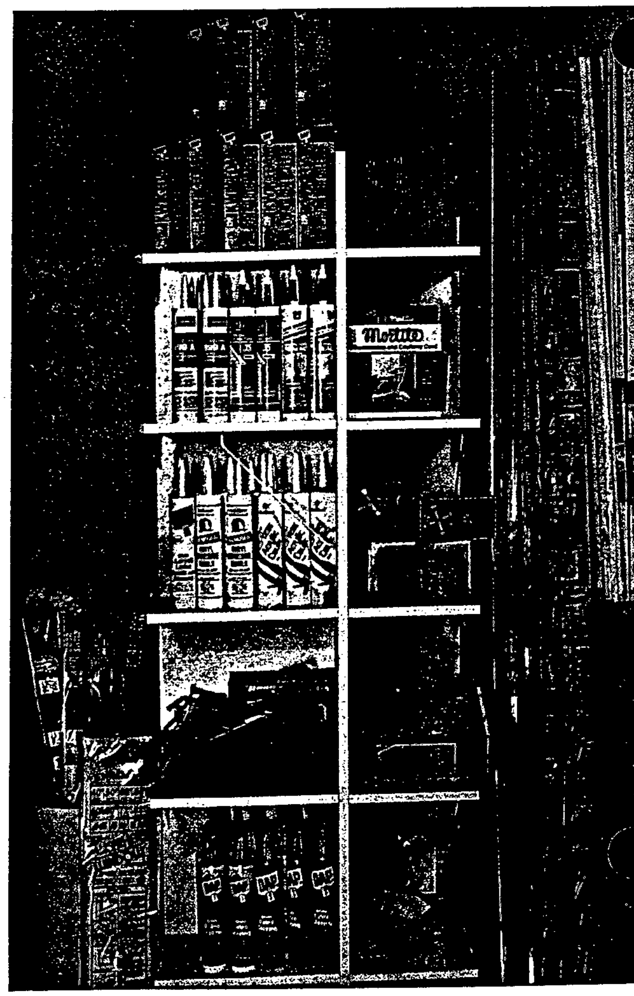
Energy Federation, Inc.
354 Waverly Street
Framingham, MA 01701
(800) 876-0660

Resource Conservation Products for the 1990's!

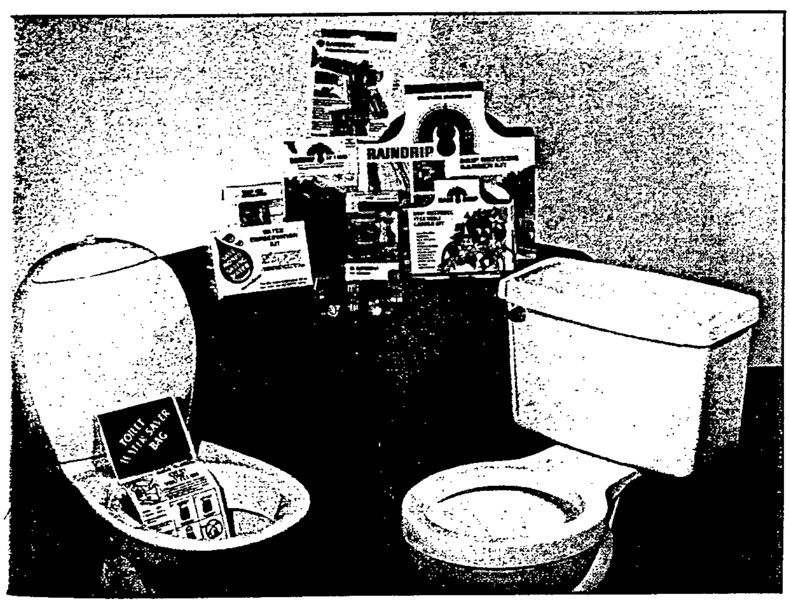


Energy Efficient Lighting

Weatherization Materials



EFI Energy Federation, Inc.



Water Conservation Products

Water Conservation Products

Water-saving Faucet Aerators

EFI's standard faucet aerator is inexpensive and easy to install. It reduces the typical faucet flow from 4-6 gallons per minute (gpm) to as little as 1.5 gpm.

Aerators are dual threaded to allow for installation on virtually all modern faucets. They screw either onto, or within, the faucet arm. The male thread is 15/16"; female 55/64".

Aerators can be purchased in bulk at 500 to a case, or individually.

WP10 Standard Faucet Aerator, bulk
WP11 Faucet Aerator, single

Faucet Aerator with Shutoff Lever

This aerator has an on/off lever which allows for easy shutdown of the faucet flow when needed, while maintaining the same temperature.

It has the same flow rate and thread dimensions as the standard aerator.

WP12 Faucet Aerator with shutoff lever

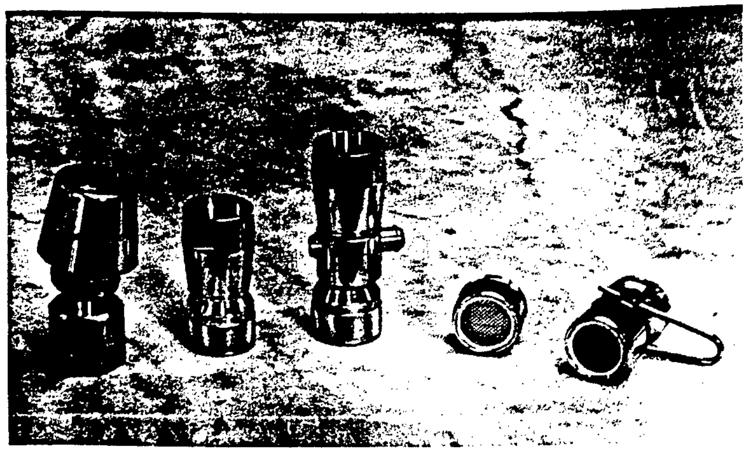
Dual Swivel and Spray Aerator

This new swivel and spray aerator switches from a steady stream to a useful spray in one easy motion. Pull down to spray, push up to aerate.

Made of non-corrosive materials, this unique aerator can be installed quickly without tools.

WP11s Dual Swivel and Spray Aerator

EFI
1 (800) 876-0660 8:30AM - 5PM E.S.T.

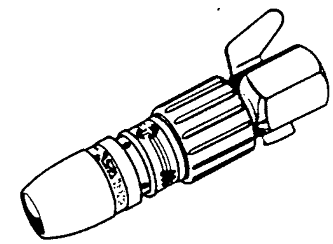


Water-saving Showerheads

EFI's standard showerheads are constructed of durable brass with chrome plating. They have an anti-hammer control valve, a flow rate of less than 2.5 gpm at 60 psi, and an adjustable spray disk. They meet ANSI spec Al 1-18-1M 1979.

The Nova 6401 showerhead was one of the first manufactured water-saving devices. It was produced for United States Navy submarines. The Nova has been refined and improved over the years, still maintaining its excellent reputation as a quality product, providing a comfortable, invigorating shower.

WP20 Showerhead, standard
WP22 Showerhead with shutoff
WP23 Male/female adapters
WP25 Nova 6401 Showerhead



SPA 2000 Showerhead

EFI's newest and most innovative showerhead, the SPA 2000 delivers the full-flow feeling of a conventional showerhead at 2.5 gpm, and saves up to 70% in water and energy costs.

The SPA 2000 *energizes* the water to create a massage-like sensation, from mild to pleasantly stimulating, with the touch of the comfort control - while maintaining the desired temperature.

Made of the finest non-corrosive materials, the SPA 2000's lifetime is virtually maintenance free.

WP24 SPA 2000 Showerhead

Resource Conservation Group Combats Water Supply/Cost Issue

The energy prices that shocked consumers a decade ago are again plaguing many Massachusetts communities in the form of doubling water and sewer rates. The Massachusetts Water Resources Authority states that Boston residents will be paying approximately $2,000/year for water by the turn of the century.

People's Energy Resource Cooperative (PERC), an EFI member group, working with the towns of Ashland and Wellesley, has offered such water conservation devices as water-saving showerheads and aerators, toilet dams, garden drip irrigation systems and water timers to residents at a discount. The towns inserted PERC order forms with water bills. PERC filled orders and provided educational and technical support.

Over 250 households responded to an initial mailing, with the average investment in materials slightly over $10. Projections are that an average family of four will save $125 annually in energy and water bills through this program. Over 8 million gallons of water will be saved each year by the residents who took advantage of this unique opportunity.

Energy Federation's Customers

EFI's primary mission is to promote the use of quality resource conservation products by making them accessible and affordable to both individuals and organizations committed to the efficient use of energy and water resources. Many of EFI's products are not easily found in conventional retail markets. This is particularly true of the energy efficient lighting products, which make up a large part of our inventory.

EFI hopes in time it will be easier for consumers to find energy and water saving products which work as advertised, do not involve great personal sacrifice, and are not priced outrageously. If and when this happens, EFI will try to be promoting a whole new line of products - working with inventors and suppliers developing improved, more efficient resource saving technologies.

EFI's customers include:

Non-profit Resource Conservation Groups

EFI's biggest customers are non-profit conservation organizations delivering conservation services locally, generally through public or utility funded contracts.

Utility Companies

EFI works with many utility companies, providing both the utility and their customers with conservation materials. EFI has participated in the design of many conservation, or 'demand-side manangement', programs. EFI also operates a number of mail order programs for various utility companies.

Low-Income Weatherization Programs

To help stretch limited public funds for low-income conservation, EFI sells weatherization materials to low-income organizations and/or contractors responsible for the work on these programs.

Conservation Conscious Consumers

EFI operates mail order programs sponsored by conservation and environmental organizations to provide their members with an opportunity to purchase quality energy and water saving materials. The local organizations 'market' the program to its members or constituents. EFI fulfills the orders. Proceeds from sales are divided between EFI and the local non-profit organization. EFI also retails directly to consumers.

EFI

Operates its bulk buying system to keep costs low on resource conservation products.

Ensures access to effective, reliable and durable materials through product research and evaluation.

Promotes environmentally benign conservation products and technologies.

Develops and supports innovative ideas encouraging the efficient use of our vital energy and water resources.

EFI has access to a greater variety of conservation and energy efficient products than we have room to list in our catalog. Please call our toll free number if you have a specific need or for additional information.

EFI Energy Federation, Inc.

Promoting Energy and Resource Conservation

354 Waverly Street

Framingham, MA 01701

(800) 876-0660 (508) 875-4921 Fax: (617) 451-1574

SCREW-IN FLUORESCENT LAMPS

The screw in fluorescent lamps are designed as replacements for incandescent lamps. There are various types of lamps available for different applications.

The criteria used for study purposes are: Incandescent lamp life is approximately 750 hours compared to 10,000 hours for compact fluorescent, maintenance savings due to avoiding the replacement of incandescent lights annually, and an average cost of $23.50 for labor and materials.

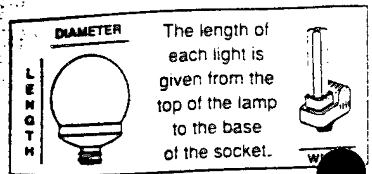
Enclosed is some product literature and the following companies manufacture these types of lamps:

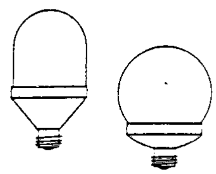
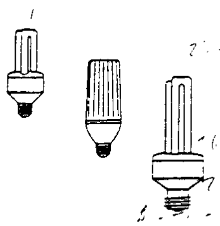
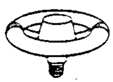
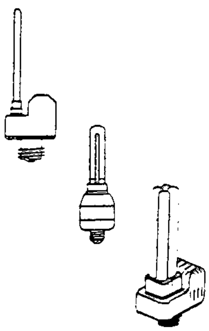
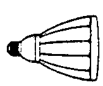
Philips Lighting Company
Philips Square
P.O. Box 6800
Somerset, New Jersey 08875
(201) 563-3000

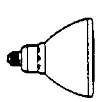
General Electric
1705 Noble Road
Cleveland, Ohio 44112
(216) 266-4256

Energy Federation, Inc.
354 Waverly Street
Framingham, MA 01701
(800) 876-0660

Technical Guide to Compact Fluorescents (CF's)





Compact Fluorescents (with rated Lumens)*	*Replacement for Incandescent** (rated Lumens)*	*CF Lifetime*** in Hours*	*Electricity Savings at 10c kwh*	*Dimensions*
One-piece Magnetic CF's				
15w Tube (720)	60w (875)	9,000	$45	3.1"D x 6.5"L
15w Globe (720)	60w	9,000	$45	3.7"D x 5.7"L
One-piece Electronic CF's				
11w Quad Style (600)	40w (480)	10,000	$29	2.25"D x 5.75"L
15w Quad Style (900)	60w	10,000	$45	2.25"D x 6.9"L
18w *Earthlight™* Capsule (1100)	75w (1190)	10,000	$57	3"D x 7.2"L
18w Panasonic Capsule (1100)				
18w Quad Style (1100)				
20w Quad Style (1200)	75w	10,000	$55	2.1"D x 7.4"L
27w Quad Style (1550)	100w (1740)	10,000	$73	2.1"D x 7.8"L
Two-piece Circular CF				
27w Circular (1200)	75w	10,000	$48	8"D x 4.5"L
Two-piece Magnetic CF's				
9w Twin w/offset adapter (600)	40w		$29	1.6"W x 2.3"D x 7.9"L
9w Twin w/center adapter (600)	40w		$29	2.4"D x 8.5"L
13w Twin w/offset adapter (900)	60w		$45	2"W x 2.4"D x 8.4"L
13w Twin w/center adapter (900)	60w	Lamp:	$45	2.4"D x 9.5"L
9w Quad w/offset adapter (575)	40w	10,000 hrs	$29	1.6"W x 2.7"D x 5.7"L
9w Quad w/center adapter (575)	40w		$29	2.4"D x 6.3"L
13w Quad w/offset adapter (880)	60w		$45	1.9"W x 2.7"D x 6"L
13w Quad w/center adapter (880)	60w	Adapter:	$45	2.4"D x 7"L
22w Quad w/offset adapter (1200)	75w	45,000 hrs	$51	1.9"W x 3.3"D x 7.5"L
22w Quad w/center adapter (1200)	75w		$51	2.8"D x 8.6"L
28w Quad w/center adapter (1600)	100w		$69	2.8"D x 9"L
Magnetic CF Reflector Kit				
13w Quad Style	75w	10,000	$60	5.25"D x 5.8"L
Electronic CF Reflectors				
11w (600)	45w	10,000	$34	4.8"D x 5.8"L
15w (900)	60w	10,000	$45	4.8"D x 7.25"L
18w (1100)	75w	10,000	$57	5"D x 7.75"L
Halogens				
42w Capsylite (665)	50w	3,500	$ 3	2.4"D x 4.25"L
52w Capsylite (885)	60w	3,500	$ 3	2.4"D x 4.25"L
72w Capsylite (1300)	80w	3,500	$ 6	2.4"D x 4.25"L
Halogen Floods				
45w (850)	75w	2,000	$ 6	4.8"D x 4.25"L
90w (1800)	125w	2,000	$12	4.8"D x 4.25"L

Please consider...

Determing your retrofit needs may take a little time and thought; two of the most important factors to consider are light output (lumens) and the CF's size (dimensions). These two factors will help you determine your light output requirements and whether or not the CF will fit in your fixture.

Currently, CF's are excellent replacements for the lower wattage incandescents - 40, 50, 60 and 75 watt. Occasionally they replace a 100 watt bulb as well. However, before you install a CF in a location where intricate visual tasks are performed, carefully check the CF's light output.

Because CF's weigh more than normal bulbs, be sure that the fixture you are retrofitting can accommodate the weight. Some floor or table lamps may become unsteady with the wrong retrofit.

A little experimenting with this innovative lighting technology can yield new opportunities to save electricity.

Important facts about CF's:

1) Do not use CF's with a dimmer switch - Ok for halogens.

2) Electronic CF's may interfere with TV/VCR remote controls.

3) CF's may not work with systems that turn lights on/off by sending a signal over house wiring.

4) CF's can be installed in fixtures with 3-way switches, but only operate at the second and third setting.

*Light output is measured in lumens, and given in parenthesis for both CF's and incandescents for comparison.

**These are only recommended retrofits: light output may be slightly lower or higher. Allow the CF to operate for a minute or two before deciding if the light ouput will meet your needs.

***A normal incandescent light bulb lasts between 750 - 1,000 hours.

OCCUPANCY SENSORS

Occupancy sensors are generally available in two types: ultrasonic sensors and infrared sensors. The ultrasonic sensors are motion detectors which broadcast sound high above the range of human hearing to sense movement. They work by bouncing ultrasonic sound waves off objects in the room and measure the time it takes for the waves to return (The Doppler Principle. Movement in the controlled area causes the sound waves to return at a different rate, resulting in a "Doppler Shift" and occupancy detection.

The infrared sensors detect the infrared heat radiated within a controlled area and are above to detect the difference between the infrared emissions from a human body and the background space.

This study does not specify which type of occupancy sensor to use. However, in most applications, the switch replacement infrared sensors should be the preferred choice.

The criteria used for study purposes are: A 15 year life and an average cost of $84 for labor and materials. This criteria is applicable to most types of sensors. The cost of sensors varies with specific application. The cost will also depend on quantity and the procurement method used.

During the design process a selection of a sensor should be made that considers not only price, but other factors such as ease of installation and any inherent problems associated with the various types of sensors.

enclosed is occupancy sensor information. Additional information may be obtained from the following companies:

The Watt Watcher
296 Brokaw Road
Santa Clara, California 95050
(408) 988-5331

Hubbell Inc.
State Street and Bostwick Avenue
Bridgeport, Connecticut 06605
(203) 337-3100

PACE Technologies
3315 Withersed Lane
Walnut Creek, California 94598
(425) .352-1802

The Watt Stopper®

Passive Infrared Wall Switch

- Simply replaces existing wall switches
- Bi-level or single-level lighting control
- Large 180°, 1000 sq ft of coverage
- Built-in light-level sensor
- Adjustable sensitivity & time delay
- Advanced transormer/latching relay design
- Compatible with electronic ballasts
- Proven 30% to 70% savings
- Available in 24VDC
- UL and CSA Listed, Five-year warranty

System Information

The Watt Stopper WI sensors replace existing wall switches and turn bi-level or single-level lighting systems on only when an office or room is occupied. The WI sensors are part of a complete integrated line of lighting controls that are based on both occupancy and daylight sensing.

Operation

Watt Stopper WI sensors use advanced passive infrared technology to detect occupancy. With a patented, 4-level, multiple-cell viewing lens, WI sensors are able to detect the difference between the infrared emissions from a human body and the background space with a high degree of accuracy. WI sensors use a unique transformer and latching-relay system which allows them to work with magnetic and hi/low ballasts and PL lamp systems (not compatible with PL low power-factor ballasts). They feature a "no-visible screws" low-profile design and an easy OFF/override.

Automatic Bi-level Manual Bi-level Single Level Control

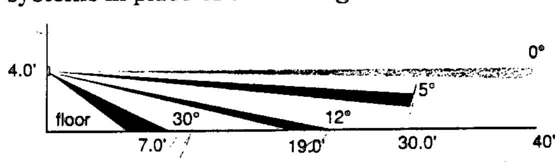
For automatic bi-level lighting control, the WI-120-4, WI-277-4, and WI-24 detect occupancy when a person enters the controlled area and switch ON one level of lighting (one load). Then, if this level of light is not above the pre-set level, the second level – or 100% of lighting – will turn on automatically. After a user-specified length of time when no occupancy is detected, lighting systems are switched off. WI sensors can also achieve manual bi-level control. Here the WI-120A, WI-277A, WI-230A or WI-347 are installed to control one level of lights while the second level is still controlled by a standard toggle switch (requires ASP112 face plate). For single-level lighting, the WI sensors switch all the lights on and off based on occupancy and daylight control.

Advanced Light-Level Sensing

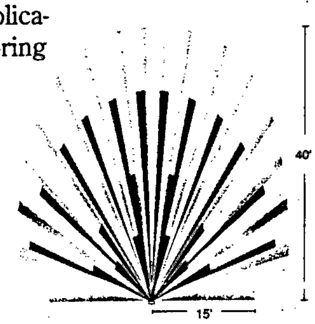
Light-level sensing is featured in all WI sensors and increases energy savings in areas with abundant natural light. This feature is adjustable by user and holds part or all of lighting systems OFF if a user-specified level of natural light already exists. A user can simply override this feature by placing his hand over the sensor for a second.

Applications & Economics

The WI sensors offer fast payback rates and are ideal for offices, utility rooms, conference rooms and most areas with fluorescent or incandescent lighting. The isolated relay in the WI-120-4 and WI-277-4 can provide additional applications and savings by interfacing with HVAC, EMS, or monitoring systems in place of controlling the second level of lighting.



WI sensors use a patented viewing lens to cover 180° with a four-level pattern which eliminates mounting height problems and insures accurate detection at desk-top level.



The Watt Stopper, Inc.
Santa Clara, CA 95050
TEL: (408) 988-5331
FAX: (408) 988-5373
Plano, TX 75023
1-800-879-8585

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WI Sensor Technical Information

WI Sensor Specifications

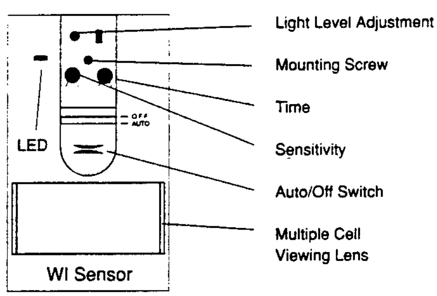
- Coverage: covers a 180° area — 40 foot range with adjustment
- Auto/OFF time delay adjustable from 30 seconds up to 30 minutes
- Adjustable unit sensitivity
- Integrated light level sensor — works from 2.4 to 300 footcandles
- LED display to indicate detection
- Advanced transformer/latching relay design
- Works with electronic ballasts and high power factor PL lamp ballasts
- No leakage current in off mode — Patent Pending
- Small size — 2.8" x 4.8" x 1" (72mm x 122mm x 26mm)
- Voltage drop protection — Patent Pending
- Integrated four-level Fresnel lens — Patented
- Available in Tamper Proof, and in White or Ivory

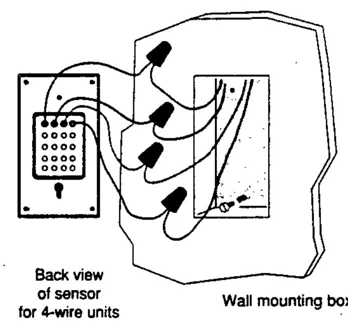
Ordering Information

Catalog No.	Voltage	Load Requirements	Coverage	Notes
WI-120-4	120 VAC	50-800 Watt Ballast–per load	1000 sq ft - 180°	1,2
WI-277-4	277 VAC	50-1000 Watt Ballast–per load	1000 sq ft - 180°	1,2
WI-120A	120 VAC	50-800 Watt Ballast	1000 sq ft - 180°	1,3
WI-277A	277 VAC	50-1000 Watt Ballast	1000 sq ft - 180°	1,3
WI-230A	220-240 VAC	50-1000 Watt Ballast	1000 sq ft - 180°	1
WI-347	347 VAC	50-1000 Watt Ballast	1000 sq ft - 180°	1
WI-24	24 VDC	Two 24 VDC outputs	1000 sq ft - 180°	1,4
WI-R7P	24 VDC Halfwave	Three RR7 Relays	1000 sq ft - 180°	1,5
ASP-111	Blank Plate for Two Gang Box			
ASP-112	Switch Plate Cover for Manual Bi-level Lighting			

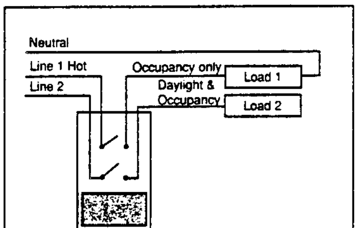
Notes: **1** - Add a **TP** to Catalog No. for Tamper Proof, add a **W** for White or **I** for Ivory
2 - For bi-level lighting; controls 2 separate lighting loads or electronically switched ballasts
3 - For 3 way applications, add a **-3** to Catalog No.
4 - Used with Watt Stopper Power Packs, **5** - For half-wave pulse, low-voltage lighting systems

Product Controls and Installation

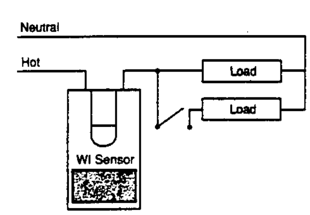


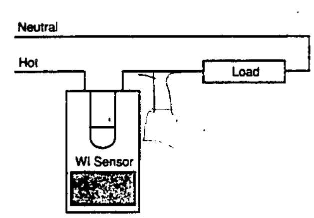


Circuit Schematics

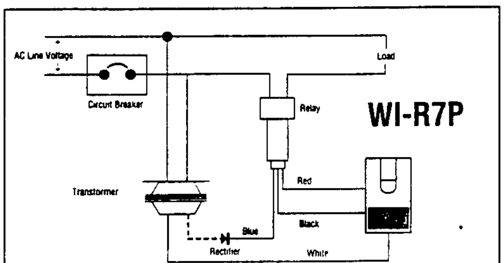


Automatic Bi-Level Lighting
WI-120-4, WI-277-4

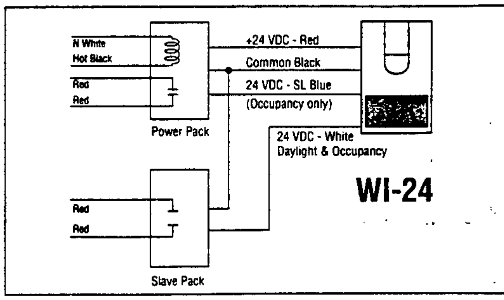




Manual Bi-Level Lighting **Single Switch**
WI-120A, WI-277A, WI-230A, WI-347



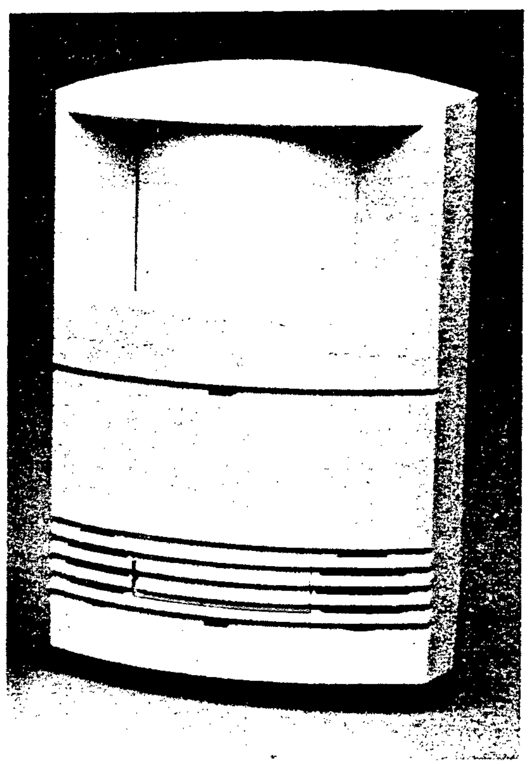
*Rectifier must be present for proper operation.



The Watt Stopper, Inc.
Santa Clara, CA 95050

Pub. No. 0304

Dual Technology Occupancy Sensor



DT-100L: PIR • ultrasonic • light-level
Occupancy Sensor for Lighting, HVAC, EMS

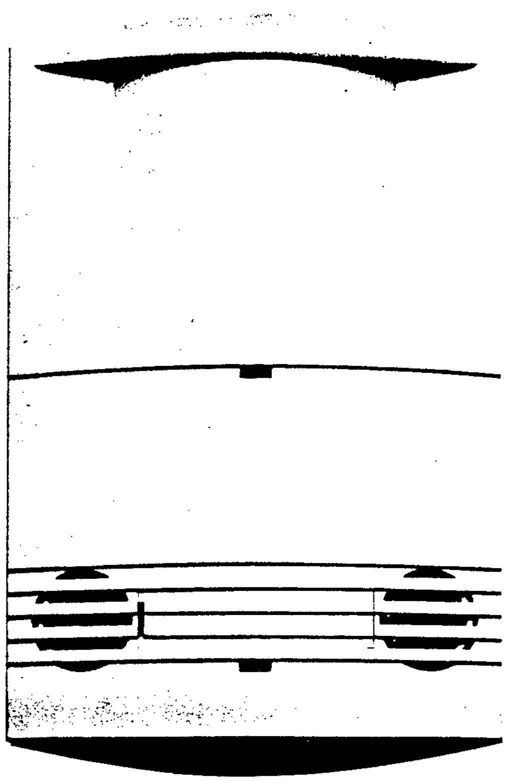
TheWatt Stopper®

DT-100L: Breakthrough in occupancy sensor technology.

Features

- ✔ The DT-100L is the first lighting control sensor to combine ultrasonic and passive infrared technologies into one unit.
- ✔ Built-in light level sensor holds part of lighting systems off when natural light is available.
- ✔ Isolated relay contact allows the DT-100L to control HVAC or to communicate with other systems.
- ✔ Customizeability for specific coverage patterns.
- ✔ Five logic configurations of infrared and ultrasonic detection.

DT-100L
Occupancy Sensor



NOW, there's an occupancy sensor that can handle the very toughest applications.

It's called the DT-100L from Watt Stopper and it combines ultrasonic and passive infrared technologies into one dependable unit.

The DT-100L includes a light level sensor that saves energy when natural light is present, and also has an isolated relay contact to control HVAC or to communicate with other building systems.

The combined technology means it rarely false triggers. And, it offers you an unprecedented level of control.

It's designed to save you money in the worst sensor environments. In places like computer rooms, large conference rooms, even obstructed utility rooms — anywhere single-technology sensors can false-trigger or non-trigger — the DT-100L performs flawlessly.

Highest Reliability

There's a simple reason why we built the DT-100L with both infrared and ultrasonic sensors.

It simply works better under tough conditions.

Because of its dual-technology design, the standard DT-100L won't switch lighting systems on until both the infrared and ultrasonic technologies detect occupancy. So there is little chance for false-triggering — a problem for single-mode sensors where vibration, HVAC vents, outside heat sources or any other motion is present.

Once triggered, the DT-100L will hold lighting systems on even if only one of the technologies — infrared or ultrasonic — detects occupancy. So there's little chance for hazardous false-off triggers.

The DT-100L offers five logic configurations of ultrasonic and infrared technology control.

Technology Control Options

Options	To Turn On	To Stay On
1*	Combined	Either
2	Either	Either
3	Infrared Only	Infrared Only
4	Ultrasonic Only	Ultrasonic Only
5	Combined	Combined

* Standard Setting - Option changes available on all units; adjustable by user.

This means it's now possible to control — and save money in — every room or office space anywhere in your building.

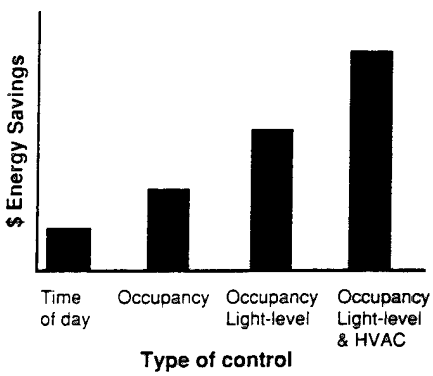
The DT-100L will save you money where other sensors can't.

Big Savings/Fast Paybacks

The DT-100L will outsave any other sensor on the market. For example, its resistance to false triggering allows us to increase unit sensitivity. Which means you can reduce the amount of time lights remain on once an occupant leaves an office.

So the savings mount as lighting systems stay off.

How You Can Save with DT-100L



In areas where an adequate amount of natural light is available — like lobbies and peripheral offices — the built-in light level sensor makes even greater savings possible. It holds some lighting levels off when natural light can do the job.

The isolated relay allows the DT-100L to also save on HVAC control or energy management monitoring when spaces are unoccupied.

So you save three ways.

Get The Sensor That Saves Everywhere

The DT-100L is a breakthrough in occupancy sensor design.

And its trouble-free operation is bound to win us a few fans among those who've had trouble with other occupancy sensors.

Whether you plan to use the DT-100L where single-mode sensors won't work, or if you want to take advantage of the superior savings throughout your building, there's one thing you should remember.

When you need a sensor with the highest level of reliability and savings – you need Watt Stopper's DT-100L.

Order Information

Catalog No.	Description
DT-100L	Dual Technology Sensor with Light Level Sensor
CM-100	Ceiling Mount Bracket
BR-1	Swivel Mount Bracket

Notes:
Dense Wide Angle lens is standard (see back side).
Add -1 after catalog no. for Long Range lens.
Add -2 . for Extra Wide Angle lens.
All units are white and work with Watt Stopper power packs.
CM-100 attaches to standard electrical enclosures.

The DT-100L is UL and CSA listed.

DT-100L Applications

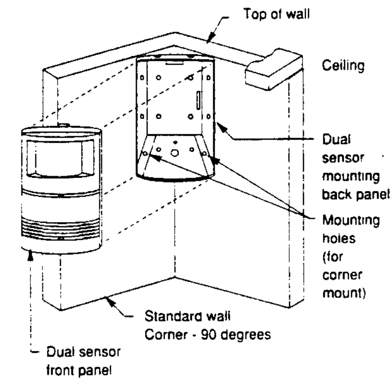
- ✔ **Large conference rooms** – where audiences remain still for long periods of time, the DT-100L won't false-OFF.
- ✔ **Classrooms** – where HVAC moves objects hanging from the ceiling back and forth, the DT-100L won't false-ON.
- ✔ **Large storage areas** – the DT-100L can use one of 3 custom IR lenses to cover long distances while using ultrasonic to cover nearby areas, regardless of obstructions.
- ✔ **Computer rooms** – where vibration and heavy HVAC activity render single-technology sensors almost worthless, the DT-100L functions flawlessly.
- ✔ **Lobbies & windowed areas** – the DT-100L's built-in light level sensor saves money by using less artificial lighting when natural light can do the job.
- ✔ **Tough open office areas** – here, the DT-100L is perfect – the ultrasonic can "see" around partitions and the infrared sensor can be strictly controlled to the intended area and reduce false triggers.

Technical Information

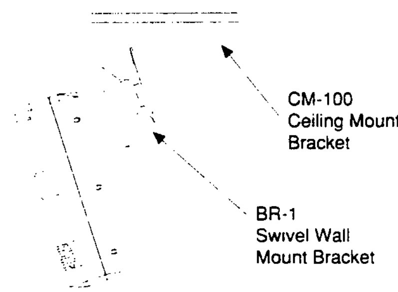
Mounting

The DT-100L can be mounted to a ceiling or a wall. Special mounting brackets are available for each, but may not be necessary.

Corner Mounting

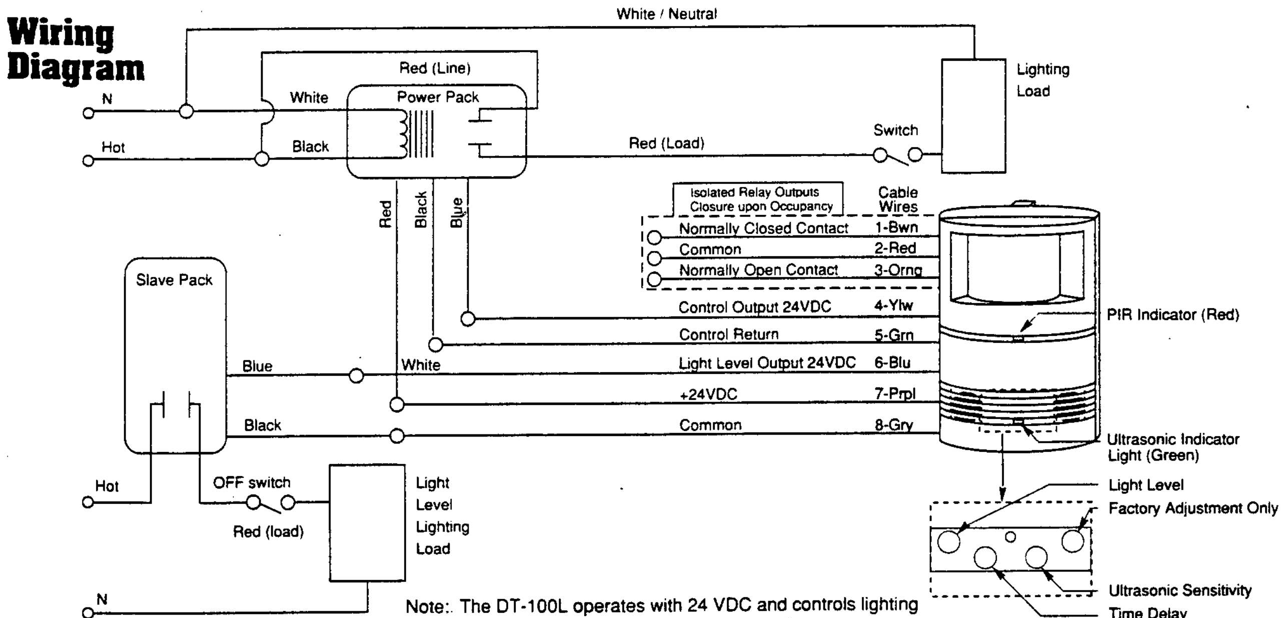


Mounting Brackets



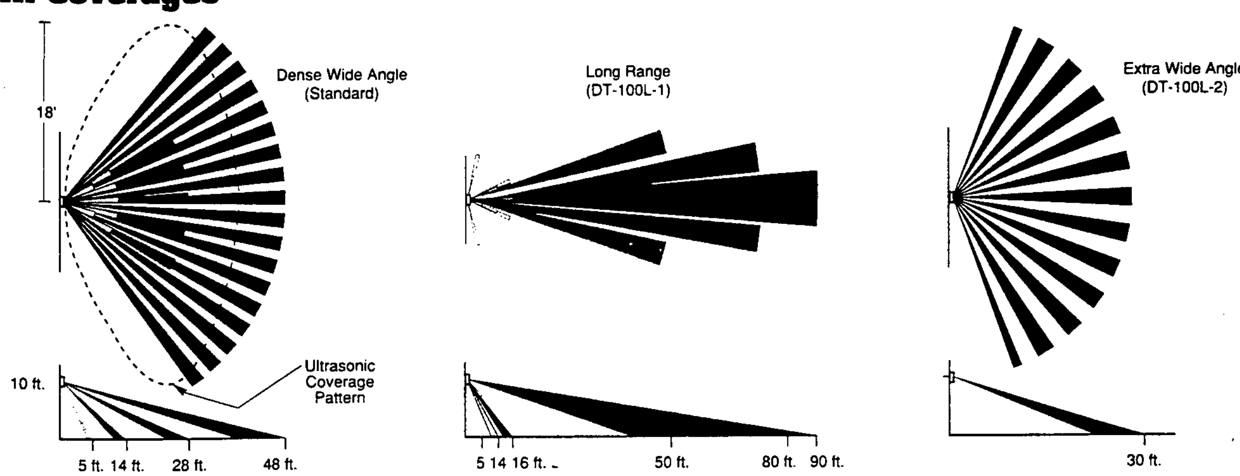
Note: Mounting brackets can be used individually or the BR-1 can be mounted on to the CM-100 as shown.

Wiring Diagram



Note: The DT-100L operates with 24 VDC and controls lighting systems through a Watt Stopper Power Pack.

PIR Coverages



Note: Coverages shown are maximum coverages and represent half-step walking motion. Ultrasonic coverage is the same on all models of the DT-100L.

296 Brokaw Road Santa Clara, CA 95050
(408) 988-5331 (800) 879-8585 (408) 988-5373 Fax

ENERGY SAVING FLUORESCENT LAMPS

Energy saving fluorescent lamps is a general term used to describe fluorescent lamps that are designed to operate at a reduced energy wattage. In most instances, the existing fluorescent lamps are a standard 40-watt fluorescent lamps. The proposed energy-savings lamps have nominal wattage of 34 watts. These lamps re not designed to be used in low temperatures or in conjunction with dimmers or low power factor ballasts.

The criteria used for study purposes are: A lamp life of 20,000 hours, and an average cost of $4.85 per lamp for labor and materials. The actual cost of the energy saver fluorescent lamps will vary depending on the quantity purchased and the procurement method used.

Enclosed is some information on energy saving fluorescent lamps. The following companies are manufacturers of energy saving lamps:

General Electric
1705 Noble Road
Cleveland, Ohio 44112
(216) 266-4256

Philips Lighting Company
Philips Square
P.O.Box 6800
Somerset, New Jersey 08875
(201) 563-3000

FLUORESCENT

Ordering Code Cross Reference Guide

Although certain fluorescent lamp types listed by Philips, General Electric and Sylvania have different ordering codes, they are physically and electrically interchangeable. For your convenience, we are listing a direct type comparison between manufacturers.

In certain areas the Philips lamp offers a customer advantage over its competitive counterpart. For example, the Philips F40T12/IS/60 and F90T12/60 lamps offer the advantages of easier handling and stocking over the competitive T-17 lamp.

In the Econ-o-watt line only Philips makes an F40/EW-PH lamp for preheat installations.

Fluorescent Lamp Interchangeability Comparison

Philips	General Electric	Sylvania
PL*5/27	—	F5TT/27K
PL*7/27	F7TT/SPX27	F7TT/27K
PL*9/27	F9TT/SPX27	F9TT/27K
PL*13/27	F13TT/SPX27	F13TT/27K
PL*18/41	F18BX/SPX41	—
PL*24/41	F24BX/SPX41	—
PL*36/35	F39BX/SPX35	—
PLC*10MM/13W/27/USA	—	F13DTT/27K
F15T8/CW/24	F24"T8/CW/4	F18T8/CW/K/24
F16T8/CW/26	F26"T8/CW/4	F18T8/CW/K/26
F17T8/CW/28	F28"T8/CW/4	F18T8/CW/K/28
F18T8/CW/30	F30"T8/CW/4	F18T8/CW/K/30
F20T12/CW (6 Pack)	F20T12/CW (6 Pack)	F20T12/CW/6
F25T12/CW	F25T12/CW/33	F25T12/CW/33
F30T12/CW/RS/EW-II	F30T12/CW/RS/WM	F30T12/CW/RS/SS
FO25/41	F25T8/SP41/RS	FO25/41K
FO32/41	F32T8/SP41/RS	FO32/41K
FO40/41	F40T8/SP41/RS	FO40/41K
F40CW/RS/EW-II	F40CW/RS/WM	F40CW/RS/SS
F40LW/RS/EW-II	F40LW/RS/WM-II	F40LW/RS/SS
F42T8/CW/EW	F42T6/CW	F42T6/CW
F64T8/CW/EW	F64T6/CW	F64T6/CW
F96T12/CW/EW	F96T12/CW/WM	F96T12/CW/SS
F96T12CW/HO/EW	F96T12/CW/HO/WM	F96T12/CW/HO/SS
F96T12CW/VHO/EW	F96PG17/CW/WM	F96T12/CW/VHO/SS
F40CW/RFL	FR40CW	FR40CW/235
FB40CW/6/EW-II	F40CW/U/6/WM	FB40CW/6/SS
FB40CW/3	FB40CW/U/3	—
FB40CW/6	F40CW/U/6	FB40/CW/6"
F40T12/CW/IS/60	F40T17/CW/IS	F40T17/CW/IS
F90T12/CW/60/EW	F90T17/CW	F90T17/CW
F48T12/CW/VHO	F48T12/CW/1500	F48T12/CW/VHO
	F48PG17/CW	
F72T12/CW/VHO	F72T12/CW/1500	F72T12/CW/VHO
	F72PG17/CW	
F96T12/CW/VHO	F96T12/CW/1500	F96T12/CW/VHO
	F96PG17/CW	
F48T12/CW/VHO-O	F48T12/CW/1500/0	F48T12/CW/VHO/LT
		F48T12/CW/VHO/O
F60T12/CW/VHO-O	F60T10/CW	—
F72T12/CW/VHO-O	F72T12/CW/1500/0	F72T12/CW/VHO/LT
		F72T12/CW/VHO/O
F96T12/CW/VHO-O	F96T12/CW/1500/0	F96T12/CW/VHO/LT
		F96T12/CW/VHO/O
FJ48T12/CW/VHO-O	F48T10J/CW	FJ48T12/CW/VHO/LT
FJ60T12/CW/VHO-O	F60T10J/CW	—
FJ72T12/CW/VHO-O	F72T10J/CW	FJ72T12/CW/VHO/LT
FJ96T12/CW/VHO-O	F96T10J/CW	FJ96T12/CW/VHO/LT

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Lamp Catalog — Specification Guide

This catalog lists Philips Lighting Company Incandescent, Fluorescent and High Intensity Discharge lamps, Miniature and Sealed Beam, Photo, Projection, Sound Reproducer and Film Viewer Lamps, Stage, Studio and TV Lamps, and Specialty Lamps. They are listed in wattage sequence except for special groupings such as Street Lighting, Quartz Infrared, Tungsten Halogen, High Intensity and Silicone Coated lamps.

Ordering Code
The complete information shown in the ordering code column together with the voltage, if applicable, should be used when placing orders.

In a number of instances a lamp type may be available in different kinds of packaging such as 2 or 4 lamp wrappers. Some small lamp types which are generally multiple packed on a platform with an overwrap are also packaged as a blister carded item for the retail market. Each of these items is shown as a separate listing. To identify them, additional information is included with the ordering code. The following examples illustrate this:

Ordering Code	Pkg. Qty.•	Explanation
BC-7T7/W 12/2	120cds	Carded pack-2 lps per card. The number shown in the "Pkg. Qty." column is the number of cards per minimum shipping case.
60T/SW 12/4	48	12-4 lp wrappers = 48 lps per minimum shipping case.
50/150T/WL /TP 96/1	96	96-1 lp wrappers = 96 lps per minimum shipping case.

• Quantity shown is minimum shipping container. Refer to Net Price Schedules for number of lamps required for qualification as a standard case.

▯ Exclusive Product
Lamps exclusively manufactured by Philips are designated by a ▯ to the left of the NAED Number.

High Volume Types
Lamps that move in relatively high volume are highlighted by a tinted area.

Lamp Life and Lumens
Approximate hours life and approximate initial lumen ratings represent average performance under specified test conditions.

Burning Position
Lamps may be burned in any position unless otherwise noted.

Voltage
Lamps listed are available only in the voltages shown.

Lamps listed in range voltages such as 115-125 or 230-250 are intended for use on circuits normally varying within these voltage limits and are designed for an average voltage suitable for operation on such circuits. Lamps intended for operation in range voltages have a design volt center as follows, unless otherwise noted by a footnote:

Range Voltage	Design Voltage
115-125	120
120-125	120
120-130	125
125-130	130
230-250	240

Class of Lamp
Incandescent lamps are classified as type B or type C. The type B lamp is one in which the filament operates in a vacuum. The type C lamp is one in which the filament operates in an atmosphere of inert gas. For gas-filled lamps which can be burned in any position the lumen maintenance is best when lamps are burned base up. For the vacuum type lamps which have no restrictions on burning position the lumen maintenance is the same in all burning positions.

Lamp Dimensions
Bulb Designations consist of a letter or letters to indicate shape and a number to indicate the approximate diameter in eighths of an inch.

Maximum Overall Length is measured from the top of the bulb to bottom of the base.

Nominal lamp length for fluorescent lamps includes the proper allowance for standard lamp holders.

Light center length is the distance from the center of the filament or center of the arc for high intensity discharge lamps to the point shown below for the base indicated.

All Screw Bases — Bottom base contact

Medium and Mogul Prefocus — Top of base fin

Medium Bipost — Bottom of bulb

Bayonet Candelabra and Medium Bayonet — Top of base pins

SC or DC Prefocus — Plane of locating bosses of prefocusing collar

Mini-Can — Intersection of 45° taper with maximum diameter of base

Base Pin Position for Bayonet Candelabra Based Lamps
When lamps are based with a bayonet candelabra base, the plane of the base pins will be approximately at right angles to the plane of the filament, unless otherwise indicated.

SC or DC Prefocus Based Lamps
The plane containing the base axis and the major locking eyelet which is the eyelet equidistant from the other two eyelets, will be at right angles to the plane of the filament or lead wires unless otherwise indicated.

The letter (A) shown in the Base column after SC or DC Pref. based lamps indicates that the distance from the bottom of base contact or contacts to the bottom of the collar is .406". In the case of DC Pref. based lamps, the letter (A) also indicates that the plane containing the base axis and contacts is at right angles to the plane containing the base axis and the major locking eyelet.

Metric Equivalents

Lamp Length English (Inches)	Metric (Millimeters)
6	152.4
9	228.6
12	304.8
15	381.0
18	457.2
21	533.4
24	609.6
33	838.2
36	914.4
42	1066.8
48	1219.2
60	1524.0
64	1625.6
72	1828.8
84	2133.6
96	2438.4

Bulb Diameter

Diameter	Millimeters
T-5	15.9
T-6	19.1
T-8	25.4
T-9	28.6
T-10	31.8
T-12	38.1

The following are Trade-Marks of Philips Lighting Company:

Advantage X
Agro-Lite
Beauty Tone®
Brooder-Lite
Bug-A-Way®
Ceramalux
Colortone®
Econo-Miser
Econ-o-Par
Econ-o-watt®
HalogènA
Heat-Ray
Lifeguard®
Luma-Circle
Luma-Stick
Octolume
Philinea
Rough House
Sterilamp®
Style-Tone
SureSpot
Tough Bulb
Ultralume
Watt Watcher®
Weather Duty®

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Lamp Substitution Guide

Present Lamp	Substitute Lamp	Light Level (1)	Watts Saved	Annual Cost Savings Per Socket (2)
Fluorescent Lamps				
F96T12	F96T12/EW	89%(3)	15	$6.00
F96T12/HO	F96T12/HO/EW	90%(3)	15	$6.00
F96T12/VHO	F96T12/VHO/EW	90%	30	$12.00
FB40/6	FB40/6/EW-II	88%	6	$2.40
High Intensity Discharge (H.I.D.) Lamps				
H39KC175/DX	C100S54(4)	104%	75(5)	$30.00
H33GL400/DX	C200S66(4)	96%	200(5)	$80.00
300M	C150S56(4)	250%	120(5)	$48.00
750	C150S56(4)	104%	570(5)	$228.00
1000	C150S56(4)	87%	820(5)	$328.00
MH400/4	MH300/4	70%	100(5)	$40.00
MH400/C	MH300/C	70%	100(5)	$40.00

(1) Light level is illumination, or footcandles, not the lumen output of the lamp, and is expressed as % of present level.

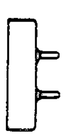
(2) Based on 4,000 hours/year and $0.10/KWH.

(3) By substituting Lite White lamps, the light levels will be 93% for the F40/RS/EW-II, 95% for the F96T12/EW, and 96% for the F96T12/HO/EW and F96T12/VHO/EW; watts saved will be the same.

(4) New fixture or ballast required for all lamp conversions.

(5) Includes ballast watts.

Nominal Lamp Watts	Bulb	Base(216)		NAED Number 04-6677-	Ordering Code	Pg. Qty.•	Description	Nominal Length (In.)(201)	Aver. Life. Hrs. (202)	Approx. Initial(203) Lumens(204)
Ultralume Preheat Fluorescent Lamps										
20	T-12	Md. Bipin		31522-6	**F20T12/30U**	24	3000K Ultralume	24	9000	1360
				37999-0	**F20T12/35U**	24	3500K Ultralume	24	9000	1360
			□	31523-4	**F20T12/41U**	24	4100K Ultralume	24	9000	1360
			□	31524-2	**F20T12/50U**	24	5000K Ultralume	24	9000	1360
Preheat Fluorescent Lamps										
25	T-12	Md. Bipin		26030-7	**F25T12/CW**	24	Cool White	33	7500	1950
				26041-4	**F25T12/D**	24	Daylight	33	7500	1650
				30126-7	**F25T12/W**	6	White	33	7500	1950
				30125-9	**F25T12/WW**	6	Warm White	33	7500	1950
Econ-o-watt Preheat Fluorescent Lamps Replaces F90T17 lamps. They are physically and electrically interchangeable.										
84	T-12	Mg. Bipin	$$$	25106-6	**F90T12/CW/60/EW**	24	Cool White	60	9000	6250
			$$$	28764-9	**F90T12/D/60/EW**	24	Daylight	60	9000	5400
			$$$	28394-5	**F90T12/W/60/EW**	24	White	60	9000	6400
Econ-o-watt Rapid Start Fluorescent Lamps										
25	T-12	Md. Bipin	$$$	35984-4	**F30T12/CW/RS/EW-II**	24	Cool White(209)(214)	36	18000	2000
			$$$	35985-1	**F30T12/WW/RS/EW-II**	24	Warm White(209)(214)	36	18000	2050
Rapid Start Fluorescent Lamps										
30	T-12	Md. Bipin		26076-0	**F30T12/CW/RS**	24	Cool White	36	18000	2300
				26078-6	**F30T12/CWX/RS**	24	Deluxe Cool White	36	18000	1600
				26085-1	**F30T12/D/RS**	24	Daylight	36	18000	1950
			†	22115-0	**F30T12/SPEC35/RS**	24	3500K SPEC	36	18000	2400
				26083-6	**F30T12/W/RS**	24	White	36	18000	2370
				26079-4	**F30T12/WW/RS**	24	Warm White	36	18000	2370
				26886-2	**F30T12/WWX/RS**	24	Deluxe Warm White	36	18000	1600
				26808-6	**F30T12/RS/C50**	24	Colortone 50	36	18000	1280
Ultralume Rapid Start Fluorescent Lamps										
30	T-12	Md. Bipin		31525-9	**F30T12/30U/RS**	24	3000K Ultralume	36	18000	2400
			†	38001-4	**F30T12/35U/RS**	24	3500K Ultralume	36	18000	2400
			□	31526-7	**F30T12/41U/RS**	24	4100K Ultralume	36	18000	2400
			□	31528-3	**F30T12/50U/RS**	24	5000K Ultralume	36	18000	2400
Octolume Rapid Start Fluorescent Lamps Use only with 265 ma ballasts										
25	T-8	Md. Bipin		37196-3	**F025/30**	25	3000K Octolume	36	20000	2150
				37197-1	**F025/41**	25	4100K Octolume	36	20000	2150
32	T-8	Md. Bipin		28474-5	**F032/30**	25	3000K Octolume	48	20000	2900
			†	22229-9	**F032/35**	25	3500K Octolume	48	20000	2900
				28475-2	**F032/41**	25	4100K Octolume	48	20000	2900
40	T-8	Md. Bipin		34800-3	**F040/30**	25	3000K Octolume	60	20000	3650
				34801-1	**F040/41**	25	4100K Octolume	60	20000	3650
Econ-o-watt Rapid Start Fluorescent Lamps										
34	T-12	Md. Bipin	$$$	28484-4	**F40CW/RS/EW-II**	30	Cool White(214)	48	20000 +	2775
			$$$	35786-3	**F40CW/RS/EW-II**	600	Cool White, Palletized(214)	48	20000 +	2775
			$$$	28511-4	**F40CWX/RS/EW-II**	30	Deluxe Cool White(214)	48	20000 +	1925
			$$$	28545-2	**F40D/RS/EW-II**	30	Daylight(214)	48	20000 +	2350
			$$$	28534-6	**F40LW/RS/EW-II**	30	Lite White(214)	48	20000 +	2925
			$$$	35790-5	**F40LW/RS/EW-II**	600	Lite White, Palletized(214)	48	20000 +	2925
			$$$	31553-1	**F40SPEC30/RS/EW-II**	30	3000K SPEC(214)	48	20000 +	2925
			$$$	37992-5	**F40SPEC35/RS/EW-II**	30	3500K SPEC(214)	48	20000 +	2925
			$$$	31546-5	**F40SPEC41/RS/EW-II**	30	4100K SPEC(214)	48	20000 +	2925



□ Exclusive Product $$$ Energy Saving Product   ▭ High Volume Lamps   †New Since Last Printing

FLUORESCENT

Fluorescent Lamps

FLUORESCENT

Nominal Lamp Watts	Bulb	Base(216)	NAED Number 04-6677-	Ordering Code	Pg. Qty.●	Description	Nominal Length (In.)(201)	Aver. Life. Hrs. (202)	Approx. Initial(203) Lumens(204)

Econ-o-watt Rapid Start Fluorescent Lamps

34	T-12	Md. Bipin $$$	28546-0	**F40W/RS/EW-II**	30	White(214)	48	20000+	2825
		$$$	28547-8	**F40WW/RS/EW-II**	30	Warm White(214)	48	20000+	2825
		$$$	36441-4	**F40WW/RS/EW-II/EM**	6	Warm White, Retail Pack(214)	48	20000+	2825
		$$$	35791-3	**F40WW/RS/EW-II**	600	Warm White, Palletized(214)	48	20000+	2825
		$$$	28527-0	**F40WWX/RS/EW-II**	30	Deluxe Warm White(214)	48	20000+	1925

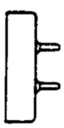
Ultralume Econ-o-watt Rapid Start Lamps

34	T-12	Md. Bipin $$$	31532-5	**F40/30U/RS/EW-II**	30	3000K Ultralume(214)	48	20000+	2925
		$$$	38004-8	**F40/35U/RS/EW-II**	30	3500K Ultralume(214)	48	20000+	2925
		$$$	31533-3	**F40/41U/RS/EW-II**	30	4100K Ultralume(214)	48	20000+	2925
		▢$$$	31535-8	**F40/50U/RS/EW-II**	30	5000K Ultralume(214)	48	20000+	2925

Econ-o-watt Preheat Fluorescent Lamps

34	T-12	Md. Bipin ▢$$$	28477-8	**F40CW/EW-PH**	30	Cool White(214)(215)	48	15000+	2850
		▢$$$	28476-0	**F40WW/EW-PH**	30	Warm White(214)(215)	48	15000+	2900

Preheat — Rapid Start Fluorescent Lamps



40	T-12	Md. Bipin	30187-9	**F40CW**	30	Cool White	48	20000+	3150
			26180-0	**F40CW**	6	Cool White	48	20000+	3150
			20568-2	**F40CW**	6	Cool White, Retail Pack	48	20000+	3150
			35776-4	**F40CW**	600	Cool White, Palletized	48	20000+	3150
			30192-9	**F40CW/RFL**	30	Cool White, Reflector	48	20000+	2600
			30193-7	**F40CWX**	30	Deluxe Cool White	48	20000+	2200
			38900-7	**F40CWX**	6	Deluxe Cool White	48	20000+	2200
			30194-5	**F40D**	30	Daylight	48	20000+	2600
			26198-2	**F40D**	6	Daylight	48	20000+	2600
			30198-6	**F40N**	30	Natural	48	20000+	2100
			37924-8	**F40N**	6	Natural	48	20000+	2100
		†	22116-8	**F40/SPEC35**	30	3500 SPEC	48	20000+	3300
			36440-6	**F40SW**	6	Soft White, Retail Pack	48	20000+	2150
			30197-8	**F40W**	30	White	48	20000+	3200
			26194-1	**F40W**	6	White	48	20000+	3200
			30199-4	**F40WW**	30	Warm White	48	20000+	3200
			20604-5	**F40WW**	6	Warm White	48	20000+	3200
			35785-5	**F40WW**	600	Warm White, Palletized	48	20000+	3200
			30201-8	**F40WWX**	30	Deluxe Warm White	48	20000+	2200
			26888-8	**F40WWX**	6	Deluxe Warm White	48	20000+	2200
			30203-4	**F40C50**	30	Colortone 50	48	20000+	2200
			33464-9	**F40C75**	30	Colortone 75	48	20000+	2000
			30204-2	**F40CG**	30	Cool Green	48	20000+	2850
			31433-6	**F40CG**	6	Cool Green	48	20000+	2850
			30205-9	**F40/AGRO**	30	Agro-Lite	48	20000+	1600
			20597-1	**F40/AGRO**	6	Agro-Lite, Retail Pack	48	20000+	1600
			39631-7	**F40B**	6	Blue	48	20000+	1200
			20189-7	**F40/BB**	6	Special Blue	48	20000+	550
			39632-5	**F40G**	6	Green	48	20000+	4400
			39635-8	**F40GO**	6	Gold, Bug-A-Way	48	20000+	2400
			39633-3	**F40PK**	6	Pink	48	20000+	1160
			39634-1	**F40R**	6	Red	48	20000+	195
			31439-3	**F40BL**	6	Black Light (211)	48	20000+	
			31440-1	**F40BLB**	6	Black Lt. — Integral Filter (211)	48	20000+	

Ultralume Preheat — Rapid Start Fluorescent Lamps

40	T-12	Md. Bipin	31537-4	**F40/30U**	30	3000K Ultralume	48	20000+	3300
			38003-0	**F40/35U**	30	3500K Ultralume	48	20000+	3300
			31538-2	**F40/41U**	30	4100K Ultralume	48	20000+	3300
		▢	31539-0	**F40/50U**	30	5000K Ultralume	48	20000+	3300

▢ Exclusive Product $$$ Energy Saving Product   ▭ High Volume Lamps   †New Since Last Printing

19

COLOR FROM GENERAL ELECTRIC

SPECIFICATION SERIES FLUORESCENT LAMPS

NOW YOUR FLUORESCENT LIGHTING CAN DO WHAT IT'S NEVER DONE BEFORE...BRING COLOR TO LIFE EFFICIENTLY.

The color of light produced by a lamp has everything to do with how rich and vibrant an environment's colors appear. And in today's offices, stores and public buildings, appearance and appeal can be critical–for people and for business.

Historically, the good color rendering lamps (DeLuxe Cool White and DeLuxe Warm White), made with conventional phosphors, produce less than 70% of the light of their standard counterparts (Cool White and Warm White). The Specification Series colors (SP and SPX) combine a layer of specially developed rare earth phosphors with a layer of conventional phosphors to give both better color rendering and more light output than the standard colors. The Specification Series DeLuxe (SPX) produce more vivid colors but are more costly since they contain more of the expensive rare earth phosphors.

COOL ENVIRONMENT

SP41 and SPX41 (4100K) lamps are an excellent replacement for Cool-White and Lite White (LW), an ideal choice to improve the appearance of people and furnishings. The cool color enhances blues and greens and is suggested for areas using higher lighting levels.

MODERATE ENVIRONMENT

SP35 and SPX35 (3500K) colors were developed to provide the user with a neutral atmosphere that complements the variety of cool and warm color schemes used throughout a building. Producing a clean, crisp environment midway between the blueness of Cool White and the yellowness of Warm White. All colors appear to be enhanced when lighted with SP35 but are more vivid when lighted with SPX35.

WARM ENVIRONMENT

SP30 and SPX30 (3000K) colors are good choices to replace Warm White. They provide better color with the same warm feeling. These 3500K sources are close to incandescent in whiteness and are well suited for lower lighting levels. For more vibrant color–for restaurants, exclusive shops etc.–choose SPX30.

–For more information on specifying color, see the inside back cover.–

The two identical pictures are lighted by SPX30 on the left, cool white on the right.

GE SAVES YOU MONEY WITH

WATT-MISER ENERGY SAVING LAMPS

Reduce electricity costs quickly and easily by replacing standard wattage fluorescent lamps directly with WATT-MISER, WATT-MISER II or WATT-MISER PLUS lamps. The resulting energy savings pay for the slightly higher lamp cost very quickly–usually in just a few months–then the lamps continue saving dollars for the remaining years of lamp life.

STANDARD LAMPS	WATT-MISER WATT-MISER II WATT-MISER PLUS	WATTS SAVED PER LAMP***	DOLLARS SAVED* PER LAMP
F30T12/**/RS	F30T12/**/RS/WM	3	$ 4.32
F40**	F40**/RS/WM	5.25	$ 8.40
	F40LW/RS/WMII	5.25	$ 8.40
	F40**/RS/WMP	8	$ 9.60
F40**/U/•	F40**/U/•/WM	4.5	$ 6.48
	F40LW/U/•/WMII	4.5	$ 6.48
F48T12/**	F48T12/**/WM	9	$ 9.36
	F48T12/LW/WMII	9	$ 9.36
F96T8/CW	F96T8/CW/WM	11	$ 8.80
F96T12/**	F96T12/**/WM	18	$25.92
	F96T12/LW/WMII	18	$25.92
F96T12/**/HO	F96T12/**/HO/WM	20	$28.80
	F96T12/LW/HO/WMII	20	$28.80
F96T12/CW/1500	F96T12/CW/WM	17.5	$15.75
	F96T12/LW/WMII	17.5	$15.75
F96PG17/CW	F96PG17/CW/WM	42.5	$51.00
	F96PG17/LW/WMII	42.5	$51.00
F90T17/CW	F90T17/CW/WM	7	$ 8.40

*At $.08/kwh over the life of the Watt-Miser lamp at 12 hrs. per start.

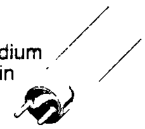
**Designates color. The popular colors, usually including SP and SPX, are available in Watt-Miser.

***Burning in typical enclosed fixture for F30 and F40 lamps, typical open fixture for all other lamps.

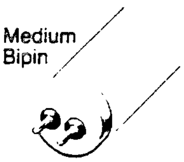
•Mod-U-Line available in both 3-inch and 6-inch leg space.

Miniature Bipin

Medium Bipin



Medium Bipin



Watts	Bulb Dia. In.	Length In.	Base	Product Ordering Code	Description	Std Pkg Qty	Additional Information See Fluorescent footnotes page 99	Rated Avg. Life / Start at 3 Hrs	Rated Avg. Life / Start at 12 Hrs	Lumens Initial	Lumens Mean at 40% Rat. Avg Life

FLUORESCENT

OPERATION — ALL GE Fluorescent lamps should be used only with auxiliary equipment designed to produce proper values. Specifications for auxiliary equipment are covered by appropriate American National Institute (ANSI) Standards. Specifications for auxiliary equipment not included in ANSI Standards are available from the Fluorescent and High Intensity Systems department.

RATINGS — Design improvements are frequently made in fluorescent lamps which tend to obsolete published ratings after a period of time. Technical bulletins will be issued from time to time if changes in ratings occur prior to the next Catalog printing. Ratings published in this catalog are based on laboratory tests under controlled conditions.

LUMENS (INITIAL) – Initial lumen ratings published herein are approx. reference ballast ratings established after 100 hours operation. Lumens delivered by lamps operated by commercial ballasts may or may not be equivalent to reference ballast ratings. Refer to ballast manufacturers' published data for the appropriate "Ballast Factor" to apply to lighting design calculations.

LUMENS (MEAN) — Mean lumens shown are the reference ballast ratings established after the lamp has operated to 40% of its rated life at 3 operating hours per start.

WATTS shown are nominal lamp watts measured on the appropriate reference ballast circuit and do not include ballast watts except as noted. Actual watts will vary depending on the commercial ballast and the type of lighting fixture used, and on the environment in which the lamp is used.

LIFE — The Rated Average Life (Hours) shown is the median life when lamps are operated for 3 hours per start on ballasts which meet ANSI Standards C-78 and C-82.1, or which meet GE Specifications where ANSI Standards do not exist.

The nominal lamp length shown is the overall dimension of the lamp including the lamp holders in which it is seated except as noted. Lamp dimensional characteristics with tolerances are found in ANSI Standard C-78.

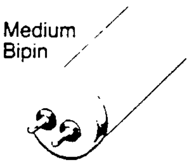
BALLASTS — The three basic fluorescent lamp ballast types are Preheat (requires a starter for each lamp), Rapid Start and Instant Start. Trigger Start ballasts, a fourth type, do not require starters and are used with Preheat lamps rated 20 watts or less.

PREHEAT FLUORESCENT LAMPS (For Use With Starters)

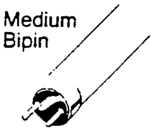
4	5/8	6	Min.Bip.	10004	**F4T5/CW**	24	Cool White (315)	6000	—	135	93
4	5/8	6	Min.Bip.	15983	**F4T5/CW CARD**	10	Cool White (315)	6000	—	135	93
4	5/8	6	Min.Bip.	10011	**F4T5/D**	24	Daylight (315)	6000	—	115	79
6	5/8	9	Min.Bip.	10032	**F6T5/CW**	24	Cool White (315)	7500	—	295	230
6	5/8	9	Min.Bip.	15986	**F6T5/CW CARD**	10	Cool White (315)	7500	—	295	230
6	5/8	9	Min.Bip	10034	**F6T5/CWX**	24	Deluxe Cool White (315)	7500	—	205	155
6	5/8	9	Min.Bip.	10028	**F6T5/D**	24	Daylight (315)	7500	—	220	165
8	5/8	12	Min.Bip.	10059	**F8T5/CW**	24	Cool White (315)	7500	—	400	300
8	5/8	12	Min.Bip.	15987	**F8T5/CW CARD**	10	Cool White (315)	7500	—	400	300
8	5/8	12	Min.Bip.	10064	**F8T5/WW**	24	Warm White (315)	7500	—	385	310
8	5/8	12	Min.Bip.	10075	**F8T5/CWX**	24	Deluxe Cool White (315)	7500	—	275	205
8	5/8	12	Min.Bip.	10055	**F8T5/D**	24	Daylight (315)	7500	—	330	265
13	5/8	21	Min.Bip.	10086	**F13T5/CW**	24	Cool White (315)	7500	—	820	655
13	5/8	21	Min.Bip	〉10089	**F13T5/WW**	24	Warm White (315)	7500	—	820	655
13	1	12	Med.Bip.	10098	**F13T8/CW**	24	Cool White	7500	—	500	400
14	1	15	Med.Bip.	10104	**F14T8/CW**	24	" "	7500	—	650	550
14	1	15	Med.Bip.	10102	**F14T8/D**	24	Daylight	7500	—	520	415
14	1½	15	Med.Bip.	10116	**F14T12/CW**	24	Cool White	9000	—	675	560
14	1½	15	Med.Bip.	10117	**F14T12/CW 6PK**	24	" "	9000	—	675	560
14	1½	15	Med.Bip.	44693	**F14T12/SW 6PK**	24	Soft White. Replaces WWX	9000	—	460	380
14	1½	15	Med.Bip.	10113	**F14T12/D**	24	Daylight	9000	—	585	485
15	1	18	Med.Bip.	10142	**F15T8/CW**	24	Cool White	7500	—	870	765

〉 New product listing.

Medium Bipin



Medium Bipin



Watts	Bulb Dia. In.	Length In.	Base	Product Ordering Code	Description	Std Pkg Qty	Additional Information See Fluorescent footnotes page 99	Rated Avg. Life / Start at 3 Hrs	Rated Avg. Life / Start at 12 Hrs	Lumens Initial	Lumens Mean at 40% Rat. Avg Life

PREHEAT FLUORESCENT LAMPS (For Use With Starters) (Continued)

30	1	36	Med.Bip.	10318	F30T8/WW	24	Warm White	7500	—	2300	2070
30	1	36	Med.Bip.	44437	F30T8/SW 6PK	24	Soft White. Replaces WWX	7500	—	1400	1150
30	1	36	Med.Bip.	10320	F30T8/CWX	24	Deluxe Cool White	7500	—	1500	1230
30	1	36	Med.Bip.	10321	F30T8/CWX 6PK	24	" "	7500	—	1500	1230
30	1	36	Med.Bip.	16323	F30T8/SPX30	24	SPX30. 3000K	7500	—	2325	2090
30	1	36	Med.Bip.	10310	F30T8/D	24	Daylight	7500	—	1900	1700
30	1	36	Med.Bip.	10311	F30T8/D 6PK	24	" "	7500	—	1900	1700
30	1	36	Med.Bip.	X10313	F30T8/W	24	White	7500	—	2250	2025
30	1	36	Med.Bip.	10328	F30T8/N	24	Natural	7500	—	1400	1150
30	1	36	Med.Bip.	10329	F30T8/N 6PK	24	" "	7500	—	1400	1150
82	2⅛	60	Mog.Bip.	43443	F90T17/CW/WM	12	WATT-MISER—Cool White	9000	15000	6100	5610
90	2⅛	60	Mog.Bip.	10643	**F90T17/CW	12	Cool White	9000	15000	6400	5890
90	2⅛	60	Mog.Bip.	10641	F90T17/D	12	Daylight	9000	15000	5650	5085

F-30 T-12 RAPID START LAMPS

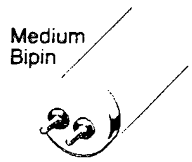
25	1½	36	Med.Bip.	44599	F30T12/CW/RS/WM	24	*WATT-MISER—Cool White	18000	—	2000	1700
25	1½	36	Med.Bip.	44600	F30T12/WW/RS/WM	24	*WATT-MISER—Warm White	18000	—	2050	1740
25	1½	36	Med.Bip.	14447	F30T12/SP30/RS/WM 24PK	24	*WATT-MISER—SP30. 3000K	18000	—	2120	1800
25	1½	36	Med.Bip.	14425	F30T12/SP35/RS/WM 24PK	24	*WATT-MISER—SP35. 3500K	18000	—	2040	1735
25	1½	36	Med.Bip.	14701	F30T12/SP41/RS/WM 24PK	24	*WATT-MISER—SP41. 4100K	18000	—	2070	1760
30	1½	36	Med.Bip.	10357	**F30T12/CW/RS	24	Cool White	18000	—	2300	1955
30	1½	36	Med.Bip.	39176	F30T12/CW/RS 6PK	24	" "	18000	—	2300	1955
30	1½	36	Med.Bip.	10359	**F30T12/WW/RS	24	Warm White	18000	—	2360	2005
30	1½	36	Med.Bip.	15266	F30T12/SP30/RS	24	SP30. 3000K	18000	—	2340	2060
30	1½	36	Med.Bip.	15085	F30T12/SP35/RS	24	SP35. 3500K	18000	—	2270	1930
30	1½	36	Med.Bip.	15267	F30T12/SP41/RS	24	SP41. 4100K	18000	—	2340	2060
30	1½	36	Med.Bip.	15108	F30T12/SPX30/RS	24	SPX30. 3000K	18000	—	2400	2040
30	1½	36	Med.Bip.	15355	F30T12/SPX35/RS	24	SPX35. 3500K	18000	—	2370	2050
30	1½	36	Med.Bip.	10358	F30T12/CWX/RS	24	Deluxe Cool White	18000	—	1530	1285
30	1½	36	Med.Bip.	10362	F30T12/WWX/RS	24	Deluxe Warm White	18000	—	1490	1190
30	1½	36	Med.Bip.	10365	F30T12/D/RS	24	Daylight	18000	—	1900	1650
30	1½	36	Med.Bip.	10363	**F30T12/W/RS	24	White	18000	—	2250	1910
30	1½	36	Med.Bip.	38115	F30T12/C50/RS	24	Chroma 50. 5000K	18000	—	1600	1280

F-40 T-12 RAPID START LAMPS

34	1½	48	Med.Bip.	13822	F40LW/RS/WMII 30PK	30	*WATT-MISER II—Lite White	20000	—	2925	2575
34	1½	48	Med.Bip.	44307	F40LW/RS/WMII 6PK	24	" "	20000	—	2925	2575
34	1½	48	Med.Bip.	11064	F40LW/RS/WMII 576-PAL	24	*WATT-MISER II—Lite White 576-Pal.	20000	—	2925	2575
34	1½	48	Med.Bip.	13803	F40CW/RS/WM 30PK	30	*WATT-MISER—Cool White	20000	—	2750	2420
34	1½	48	Med.Bip.	40987	F40CW/RS/WM 6PK	24	" "	20000	—	2750	2420
34	1½	48	Med.Bip.	11063	F40CW/RS/WM 576-PAL	24	*WATT-MISER—Cool White. 576-Pallet	20000	—	2750	2420

× No longer manufactured; available only until stocks are depleted.
★★ **FOR ENERGY SAVINGS — Use a matching color 'WATT-MISER' lamp (See chart — page 81).**
★ Use only on Rapid Start Ballasts or for more ENERGY SAVINGS use Optimser Ballasts.

FLUORESCENT LAMPS



Watts	Bulb Dia. In.	Length In.	Base	Product Ordering Code	Description	Std Pkg Qty	Additional Information See Fluorescent footnotes page 99	Rated Avg. Life / Start at 3 Hrs	Rated Avg. Life / Start at 12 Hrs	Lumens Initial	Lumens Mean at 40% Rat. Avg Life

F-40 T-12 RAPID START LAMPS (Continued)

34	1½	48	Med.Bip.	13821	F40WW/RS/WM 30PK	30	★WATT-MISER—Warm White	20000	—	2800	2465
34	1½	48	Med.Bip.	11066	F40WW/RS/WM 576-PAL	24	★WATT-MISER—Warm White. 576-Pallet	20000	—	2800	2465
34	1½	48	Med.Bip.	14200	F40SP30/RS/WM 30PK	30	★WATT-MISER—SP30. 3000K.	20000	—	2900	2550
34	1½	48	Med.Bip.	13807	F40SP35/RS/WM 30PK	30	★WATT-MISER—SP35. 3500K.	20000	—	2900	2550
34	1½	48	Med.Bip.	13809	F40SP41/RS/WM 30PK	30	★WATT-MISER—SP41. 4100K.	20000	—	2900	2550
34	1½	48	Med.Bip.	13804	F40CWX/RS/WM 30PK	30	★WATT-MISER—Deluxe Cool White	20000	—	1925	1590
34	1½	48	Med.Bip.	13808	F40WWX/RS/WM 30PK	30	★WATT-MISER—Deluxe Warm White	20000	—	1925	1590
34	1½	48	Med.Bip.	13819	F40D/RS/WM 30PK	30	★WATT-MISER—Daylight	20000	—	2300	2025
34	1½	48	Med.Bip.	13820	F40W/RS/WM 30PK	30	★WATT-MISER—White	20000	—	2800	2465
34	1½	48	Med.Bip.	12702	F40M/RS 6PK	24	★MISER—Warm Color. 3000K	20000	—	2800	2465
34	1½	48	Med.Bip.	15982	F40M/CONS30/SLV	30	Warm Color	20000	—	2800	2465
34	1½	48	Med.Bip.	14627	F40SPX30/RS/WM 30PK	30	★WATT-MISER—SPX30. 3000K	20000	—	2900	2550
34	1½	48	Med.Bip.	14628	F40SPX35/RS/WM 30PK	30	★WATT-MISER—SPX35. 3500K	20000	—	2900	2550
34	1½	48	Med.Bip.	14811	F40SPX41/RS/WM 30PK	30	★WATT-MISER—SPX41. 4100K	20000	—	2900	2550
32	1½	48	Med.Bip.	14221	F40CW/RS/WMP 30PK	30	@WATT-MISER PLUS—Cool White	15000+	—	2700	2430
32	1½	48	Med.Bip.	14223	F40WW/RS/WMP 30PK	30	@WATT-MISER PLUS—Warm White	15000+	—	2750	2475
32	1½	48	Med.Bip.	14226	F40SP30/RS/WMP 30PK	30	@WATT-MISER PLUS—SP30. 3000K	15000+	—	2850	2510
32	1½	48	Med.Bip.	14225	F40SP35/RS/WMP 30PK	30	@WATT-MISER PLUS—SP35. 3500K	15000+	—	2850	2510
32	1½	48	Med.Bip.	14224	F40SP41/RS/WMP 30PK	30	@WATT-MISER PLUS—SP41. 4100K	15000+	—	2850	2510
32	1½	48	Med.Bip.	14222	F40LW/RS/WMP 30PK	30	@WATT-MISER PLUS—Lite White	15000+	—	2875	2585

MAXIMISER™ F-40 T-12 RAPID START-PREHEAT LAMPS

40	1½	48	Med.Bip.	13816	F40LW/MMII 30PK	30	MAXI-MISER II Lite White	15000 (302)	—	3450	3140
40	1½	48	Med.Bip.	13811	F40CW/MM 30PK	30	MAXI-MISER—Cool White	15000 (302)	—	3250	2960
40	1½	48	Med.Bip.	13815	F40WW/MM 30PK	30	MAXI-MISER—Warm White	15000 (302)	—	3250	2960
40	1½	48	Med.Bip.	13812	F40D/MM 30PK	30	MAXI-MISER—Daylight	15000 (302)	—	2650	2410
40	1½	48	Med.Bip.	X13814	F40W/MM 30PK	30	MAXI-MISER—White	15000 (302)	—	3250	2960
40	1½	48	Med.Bip.	14316	F40SP30/MM 30PK	30	MAXI-MISER—SP30. 3000K	15000 (302)	—	3350	3050

× No longer manufactured; available only until stocks are depleted.
★ Use only on Rapid Start Ballasts or for more ENERGY SAVINGS use Optimser Ballasts.
@ Use only on Rapid Start Ballasts.

24

USING WATT-MISER FLUORESCENT LAMPS
Application Recommendations

NOTE: Watt-Miser lamps are intended for use where lamp ambient temperatures are 60°F. or higher. Lamp flickering may occur where lamp ambient temperature is below 60°F. or where strong air drafts blow directly on bare bulbs.

Rapid Start

F-30 WATT-MISER Lamps

F-30 Watt-Miser Fluorescent lamps are intended for use on two-lamp indoor lead-circuit high power factor rapid start ballasts or for greater system efficiency use Optimiser ballasts. Operation on low power factor ballasts, dimming and emergency lighting systems (unless approved by the system manufacturer) or operation on reduced current/reduced light output ballasts is not recommended.

F-40 WATT-MISER Lamps

F-40 Watt-Miser lamps are intended for use on single lamp and two-lamp indoor lead-circuit high power factor rapid start ballasts or for greater system efficiency use Optimiser ballasts. Operation on low power factor ballasts, dimming and emergency lighting systems (unless approved by the system manufacturer) or operation on reduced current/reduced light output ballasts is not recommended. Lamp life on single-lamp rapid start ballasts may be reduced.

F-40 WATT-MISER PLUS Lamps

F-40 Watt-Miser Plus lamps are intended for use on old, as well as new, indoor, rapid start, lead-circuit, high-power-factor ballasts in lamp ambient temperatures of 60°F or higher. Operation on low-power-factor ballasts, high frequency electronic type ballasts, impedance modifying devices, dimming, reduced-current/reduced-light-output ballasts, 3-lamp series energy-saving ballasts, or Optimiser ballasts is not recommended. Lamp life on single-lamp rapid start ballasts may be reduced. Watt-Miser Plus lamps may need approximately one minute to restart if a circuit interruption of less than 60 seconds occurs.

F-40 MOD-U-LINE WATT-MISER Lamps

F-40 MOD-U-LINE Watt-Miser lamps are intended for use on single and two-lamp indoor lead circuit, high power factor, rapid start ballasts. Operation on low power factor, dimming, emergency lighting, (unless approved by the system manufacturer) reduced current/reduced light output, MAXI-MISER™ II or Optimiser ballasts is not recommended.

F-96 and F-48 High Output (800 ma.) WATT-MISER Lamps

High Output Watt-Miser lamps are intended for use on single-lamp and two-lamp indoor lead-circuit high power factor rapid start ballasts. Operation on reduced current/reduced light output ballasts is not recommended.

F-96 and F-48 Power Groove® (1500 ma.) WATT-MISER and F-96 1500 MA. T-12 WATT-MISER Lamps

Power Groove and 1500 Ma. T-12 Watt-Miser lamps are intended for use on two-lamp indoor lead-circuit high power factor rapid start ballasts. Marginal starting may be experienced on single lamp ballasts, particularly with low primary voltage conditions.

Instant Start

F-96 and F-48 Slimline WATT-MISER Lamps

Slimline Watt-Miser lamps are intended for use on single-lamp and two-lamp indoor lead-circuit high power factor instant start ballasts. Operation on low power factor, lead-lag or reduced current/reduced light output ballasts is not recommended.

Preheat (For Use with Starters)

F-90 WATT-MISER Lamps

F-90 Watt-Miser lamps are intended for use on two-lamp indoor switch-start high power factor ballasts in open type industrial or commercial fixtures.

FLUORESCENT LAMP FOOTNOTES

301. Rated average life on Rapid Start Circuits. Rated average life on Preheat Circuits is 15,000 hours except as otherwise noted. Lamp life on Single-Lamp Rapid Start Ballasts may be reduced.
302. Rated average life on Rapid Start Circuits. Rated average life on Preheat Circuits is 12,000 hours. Lamp life on Single-Lamp Rapid Start Ballasts may be reduced.
303. Rated average life for 3 hours per start. At 1 hour per start, rated average life is 5,000 hours.
304. Show to the nearest 5 watts.
305. Made in West Germany expressly for General Electric Company.
308. When base pins or Recessed Double Contact bases are horizontal, window opening is centered in a vertical plane through lamp axis.
312. Estimated average life. Rated life is 4500 hours at 1 hour per start.
315. Made in Japan expressly for General Electric Company.
316. Replacement lamp for existing fluorescent street lighting and other outdoor installations. For new installations, the F72T12/HO lamp is recommended.
318. Rated average life on Rapid Start Circuits. Rated average life on Instant Start Circuits is 15,000 hours.
323. Nominal lamp watts are shown to the nearest 5 watts and are for 425 ma. operation.
326. Made in Canada expressly for General Electric Company.
339. For high ambient temperature applications. Nominal lamp watts and light output are peak values. Lamp requires special ballasting considerations.
343. Rated average life is 3000 hours at 45 minutes per start.
345. Nominal lamp watts and initial lumens shown are for 1000 ma. operation.
346. A starter is located in base of lamp.
347. External starter required.
353. Useful life; actual burning hours longer.

WATER HEATER TIMERS

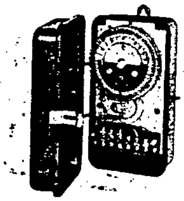
Automatic timers are available for water heaters that can be turned off during long periods of no usage. Timers can be installed to turn off the heaters at preselected times and turned back on before occupancy of the building. The criteria used for study purposes are: The water heaters can be turned off for a period of 12 hours (at night), the cost is about $58.25 for labor and materials. The actual cost of the timers will vary depending on the quantity purchased and the procurement method used.

The enclosed information is from the following manufacturer's supplier:

Grainger
2050 Magnoliea St.
Richmond, Virginia 23223-2340
(804) 649-0731

24-HOUR AND WATER HEATER TIMERS

MULTIOPERATION TIMERS



Dayton

UL E22110

- Settings per day: Up to 48 On-Off/pole
- 96 permanently fixed trippers for minimal timing increments
- Manual On-Off override does not interfere with program; except on No. 2E213
- Metal indoor enclosure with lock hasp

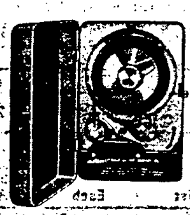
No. 2E132. Extra Trippers (12). Shpg. wt. 0.1 lbs. List....$1.67. Each....$1.50

		ELECTRICAL SPECIFICATIONS						TIMER SPECIFICATIONS				
		Contact Load Ratings @ 120-480V, 60 Hz										
No. of Poles	Stock No.	Form	Amps/Pole Resistive	Pilot Duty	HP @ 120VAC	HP @ 240VAC	Timer Input Volts @ 60 Hz	Time Setting Minimum	Time Setting Maximum	Daily On-Off Operations Per Pole	No. of Trippers Included	Order Extra Tripper Stock No.
1	2E026 6X761 2E389 6X762 2A512	SPDT	20	—	1/2	1	125V 125 208-277 208-277 480	15 Min	23¾ Hr	48	96	2E132
1	2E213	SPDT	10*	125VA	—	—	120/240	15	23¾	48	96	—

No. of Poles	Contact Form	Timer Input Volts @ 60 Hz	Enclosure Type	Day Skipper	Dimensions H	W	D	Stock No.	List	Each	Shpg. Wt.
1	SPDT	125V	Indoor	No	7¾"	5"	3"	**2E026**	$104.10	**$63.26**	2.9
		125		Yes				**6X761**	133.55	**82.39**	2.8
		208-277		No				**2E389**	106.50	**65.68**	2.8
		208-277		Yes				**6X762**	136.35	**84.11**	2.8
		480		No				**2A512**	173.93	**94.67**	3.0
1	SPDT	120/240	Outdoor	Yes	10	5½	4	**2E213**	174.63	**120.34**	5.3

(*) Rated at 120V, 60 Hz.

ADVANCE WARNING SIGNAL TIMER



PARAGON

UL E10597 — CSA LR8376

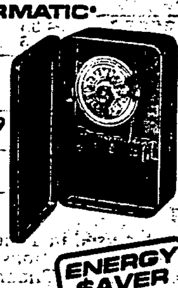
- Prewarning and main signal designed for programming audible signals such as alarms, buzzers or bells
- Secondary switch operates 1 to 3 minutes before main switch; adjustable for 4 to 60 sec of On time
- Full or half-day skipper for suspension of program in 12 or 24 hour periods, starting at 6 AM or PM
- Manual override does not interfere with program
- Metal indoor enclosure with lock hasp

No. 2E212. Advance Warning Signal Timer. Paragon brand (23001-00S). Shpg. wt. 7.9 lbs. List $405.60. Each....$346.39

	ELECTRICAL SPECIFICATIONS				TIMER SPECIFICATIONS					
	Contact Load Ratings @ 120V, 60Hz							No. of Trippers Included		
No. of Poles	Form	Amps Resistive	Pilot Duty	Timer Input Volts @ 60 Hz	Time Setting Minimum	Time Setting Maximum	Daily On-Off Operations Per Pole	Main	Secondary	Skipper
1	SPST	5	125VA	125	5 Min	23½ Hr	144	24	8	9

ELECTRIC WATER HEATER TIMERS

INTERMATIC



No. 6X769

No. 1A573

ENERGY SAVER

UL E10694

- Settings per day: Up to 12 On-Off
- Automatically turns Off water heater at pre-selected times
- Manual On-Off override (does not interfere with program); external on No. 1A573
- Metal indoor enclosure with lock hasp

	ELECTRICAL SPECIFICATIONS					TIMER SPECIFICATIONS				
	Contact Load Ratings @ 120-277V, 60Hz									
Stock No.	Form	Amps I†	Pilot Duty	HP	Timer Input Volts @ 60 Hz	Time Setting Min.	Time Setting Max	Daily On-Off Operations Per Pole	No. of Trippers Included	Order Extra Tripper No.
6X769 1A573 4A216	DPST DPST SPST	40 40 25	1000VA 1000 N/A	2 2 1	208-277V	30 Min	23½ Hr	12	2	2E054‡

No. of Poles	Enclosure Type	Dimensions H	W	D	Intermatic Model	Stock No.	List	Each	Shpg. Wt.
2	NEMA 1	7¾"	5"	3"	T104-20	**6X769**	$72.92	**$35.96**	2.9
2					WH40	**1A573**	73.10	**38.54**	2.6
1					WH21	**4A216**	36.12	**34.05**	2.4

(†) I = Inductive. (‡) Order on page 225.

EXIT SIGN REPLACEMENT

Exit signs operate 24 hours per day, 365 days per year. Incandescent exit lights use up to 50 watts per fixture for illumination. Light Emitting Diodes (LED) exit signs provide the necessary light levels at a reduced wattage. Typical LED exit lights consume about 6 watts per sign (Single face). In addition the LED fixtures last up to 30 years.

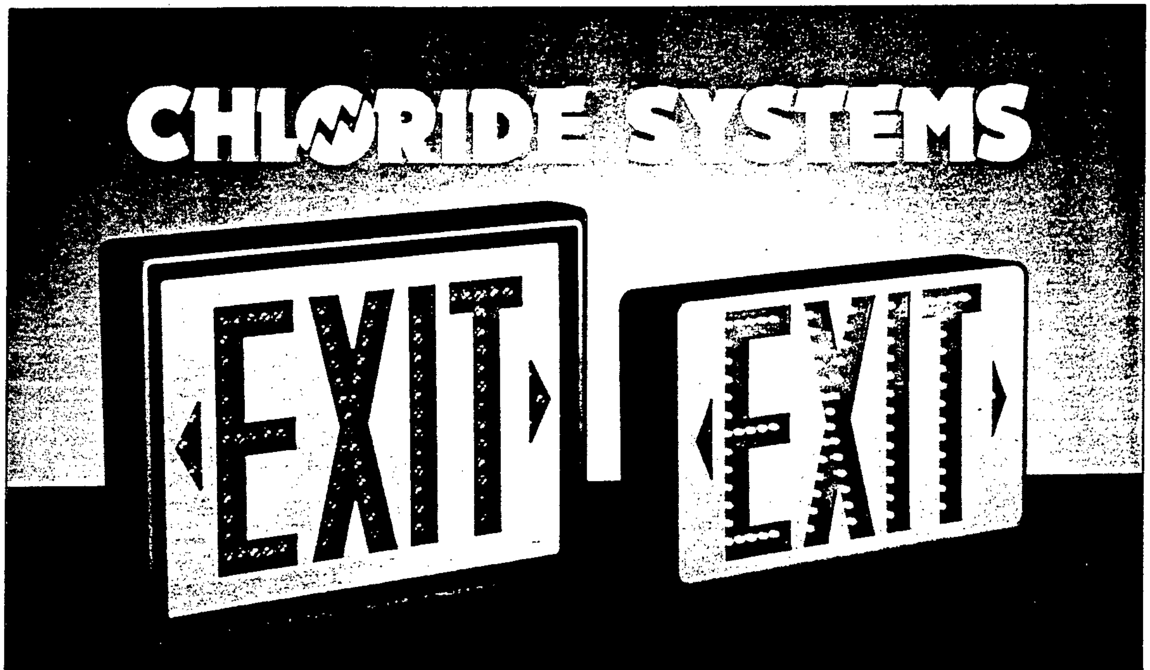
The criteria used for study purposes are: A life of 15 years (per ECIP Guidance), annual maintenance savings of about $3.15 per lamp and 3 changes per year per sign, an installed cost of about $150 per fixture for labor and materials. The actual cost of the exit sign fixtures will vary depending on the quantity purchased and the procurement method used.

The following companies are suppliers of LED exit signs:

CHLORIDE SYSTEMS
126 Chloride Road
Burgaw, NC 28425
(919) 259-1000

Infinity LED Exit Signs

AC ONLY
SELF POWERED



Die Cast (shown with optional diffuser) | **Thermoplastic**

Virtually eliminate high maintenance and operating costs by specifying Infinity exit signs. Super high intensity **Light Emitting Diodes** (LEDs) provide years of trouble-free operation. The ultimate in safe egress marking, Infinity signs ensure dependable operation in emergency and non-emergency situations. Long life combined with energy efficiency and solid state design enables Infinity exits to outperform conventional incandescent and fluorescent alternatives. With the Infinity exit series, the application flexibility is virtually limitless.

Die Cast

Rugged, durable and extremely stylish, the die cast version provides the user/specifier a sign for upgrade installations. The Infinity die cast is a thin profile, meticulously engineered sign, measuring only 1 3/4" in sign depth. Available in standard black or white, the die cast version may also be ordered in silver, gray or dark bronze. Application flexibility is realized by the use of the universal mounting canopy and the universal knock-out arrows on the face plate.

Thermoplastic

Soft-cornered contemporary design with universal knock-out directional arrows and high impact fire-retardant UL 94V-0 rated thermoplastic are the key features of the Infinity plastic exit. Available in black or white, the plastic housing has an optional aluminum type stencil face to meet the needs of any application. Installation is made easy with a quick snap-in design.

FEATURES:

- 120/277 VAC input.
- Maintenance-free nickel cadmium battery.
- High performance constant current charger.
- Low ripple, over voltage and short circuit protection LED supply.
- Brownout protection.
- Battery quick disconnect.
- AC indicator light.
- Push to test switch.
- Clear Lexan® lens standard.
- Easy installation.
- U.L. listed 924.
- Universal mounting capability.

Listed to Standard 924

Light Emitting Diodes (LEDs)

Extremely compact, solid state design is the benchmark of the LED light source. LEDs are not sensitive to vibration and consume only 6 watts per panel. Lamp life is estimated at 30+ years. The Infinity series incorporates super high intensity LEDs, with 10 footcandles illumination on the face. Full light output is maintained on double face units. Loss of one LED does not affect operation of any of the remaining LEDs in the exit.

Ordering Information

I AC L W P 1 AR CBR

- Family — I
- Power Req. — AC
- Lamp Type — L
- Frame Color — W
- Frame Material — P
- # of Faces — 1
- Letter Color — AR
- Options — CBR

Family
I=Infinity

Power Req.
AC=AC only
SP=Self Powered

Lamp Type
L=LED

Frame Color
W=White
B=Black
DB=Dark Bronze*
S=Silver*
G=Gray*
*Additional cast only colors

Frame Material
P=Plastic
D=Die Cast

# of Faces
1=Single
2=Double

Letter Color
R=Red
G=Green
RD=Red Diffused*
GD=Green Diffused*
AR= Aluminum Style Face Red Letter
AG=Aluminum Style Face Green Letter
ARD=Aluminum Style Face Red Letter Diffused*
AGD= Aluminum Style Face Green Letter Diffused*
***Diffused style includes acrylic prismatic lens**

Options
F=Fire Alarm Interface
TP= Tamper Proof Screws
C_*_=California Code
*Specify Color
Blank=master color
W=White
B=Black
A=Brushed Aluminum
S=Silver
DB=Bronze
(For complete details on the California Code Option call the factory or your agent.)

Warranty

Infinity LED exits are warranted for 5 full years. NiCad batteries are fully warranted for 1 year and 7 years pro-rata.

Suggested Specifications

Furnish and install Chloride Systems Infinity Model ________ exit sign as indicated on the plans. The exit shall be dual voltage (120/277 VAC) 60 HZ, 6 watt maximum power consumption per face.

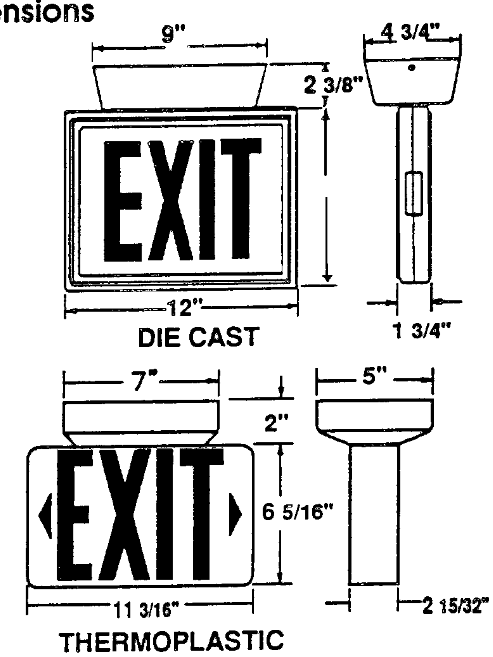
A constant current, solid state charging circuit incorporating a solid state load control switch which ensures rapid illumination upon loss of power shall be used. Battery recharging to rated capacity is to be as per U.L. Standard 924.

LED power supply shall have a low ripple, over voltage and short circuit protection which provides a constant voltage to LEDs ensuring even illumination.

LEDs shall be super high brightness type offering superior optical performance with a wide (120°) viewing angle and an estimated 30+ year life.

Battery shall be nickel cadmium with completely sealed construction and provide maintenance-free operation.

Dimensions



Specifications subject to change without prior notification.

CHLORIDE SYSTEMS

126 Chloride Road
Burgaw, NC 28425
Phone (919) 259-1000 FAX (919) 259-1149

ENERGY EFFICIENT FLUORESCENT LIGHTING SYSTEMS

Standard fluorescent lighting systems consist of four 40 watt fluorescent lamps with two ballast. These fixtures consume up to 180 watts. Areas with high periods of use can be retrofitted with the fluorescent T-8 lighting system. These systems consist of 32 watt T-8 Lamps and electronic ballast. These fixtures consume about 108 watts per fixture.

The criteria used for study purposes are: A life of 15 years (ECIP Guidance), a fixture retrofit cost of $220 for labor and materials. The existing fluorescent fixture housing will be retrofitted with new electronic ballast and T-8 lamp sockets.

Construction costs were based on a contractors quote on previous jobs. However, product literature has been included for information on T-8 systems and the following manufacturer's can be reached for more detailed information:

General Electric
1705 Noble Road
Cleveland, Ohio 44112
(216) 266-4256

Philips Lighting Company
Philips Square
P.O.Box 6800
Somerset, New Jersey 08875
(201) 563-3000

GE Trimline T8™ Lamps

On the cutting edge of lamp efficiency, the Trimline T8's 1-inch diameter offers superior design flexibility in 2, 3, 4, 5 and 8 ft. lengths. Trimmer, more innovative fixtures are able to create a more energy-efficient, attractive environment, even where space is limited.

Trimline T8 lamps are used in new construction and in upgrading older, less efficient lighting systems. They are an excellent, energy-efficient choice for general lighting in offices, conference rooms, stores and hallways. 17-watt through 40-watt Trimline lamps can be used on either rapid start, instant start or cathode cutout types of ballasts rated for T8 lamps. The F96T8 lamp can be operated on instant start ballasts only.

Rare earth phosphors for high color rendering and efficiency

Trimline lamps are available in SP color or—even better—SPX color, for superior color rendering. Color options ranging from warm to cool are available to let you create just the right atmosphere.

Long lamp life

The GE Trimline T8 lamp is designed to provide long lamp life when operated on either instant start or rapid start ballasts. At 3 hrs./start, lamp life will be 15,000 hours on an instant start ballast.

An even longer 20,000 hours of life will be obtained on a rapid start ballast. (The new F96T8 eight-foot Trimline lamp can be used on instant start ballasts only.)

High efficiency ... up to 40% reduction in wattage

F32T8 Trimline lamps are rated at 32 watts, 20% fewer watts than standard F40s, and 6% fewer than energy saving F40s. But savings of up to 40% can be realized when a GE Trimline lamp with an electronic ballast is used to replace F40 lamps on standard magnetic ballasts.

Compare the performance of GE's F32T8 Trimline lamp to that of other four-foot lamp types:

Typical Performance Comparison - Four Lamp Lensed Fixture

LAMP*	BALLAST	SYSTEM WATTS	ENERGY SAVINGS	RELATIVE LIGHT OUTPUT
F40	STANDARD	181	0	100%
F40	ENERGY SAVING	164	9%	100%
F40/WM	ENERGY SAVING	143	21%	88%
F32T8	ELECTRONIC	108	40%	96%

*Comparisons are for similar colors. Be sure to check wattage, lumens and life to determine which lamps are best suited to your needs.

Note in the preceding chart the potential for a 40% reduction in system wattage with nearly the same light output! Because of their high efficiency, GE Trimline T8 lamps are included on most energy reduction rebate programs offered by electric utilities. Cash rebates for upgrading your lighting could be substantial. Contact your local GE distributor for more information.

Performance Note:

The rated average life shown on page 4.10 for bipin based lamps is for rapid start operation. Life on instant start ballasts is 15,000 hours. Life for the F96T8 lamp is based on instant start operation at 3 hours per start.

Trimline T8™ Lamps

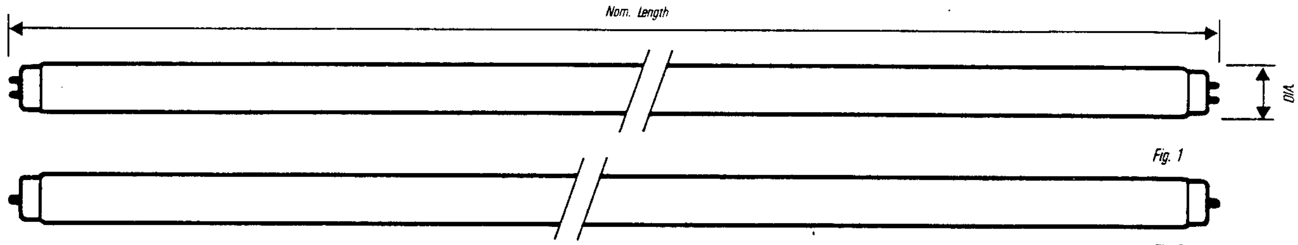


Fig. 1

Fig. 2

Watts	Nominal Length in. (mm)	Product Order Code	Description	Case Quantity	Rated Average Life Hours	Lumens Initial	Lumens Mean	Color Temp K	CRI	Additional Information
T8	**Diameter 1" (26 mm) – Medium Bipin (G13) Base** *Fig. 1*									
17	24 (610)	22642	F17T8/SPX30	24	20000	1375	1230	3000	84	RE 830 Phosphor
17	24 (610)	22646	F17T8/SPX35	24	20000	1375	1230	3500	84	RE 835 Phosphor
17	24 (610)	22647	F17T8/SPX41	24	20000	1375	1230	4100	80	RE 841 Phosphor
17	24 (610)	17033	F17T8/SP30	24	20000	1325	1190	3000	75	RE 730 Phosphor
17	24 (610)	17035	F17T8/SP35	24	20000	1325	1190	3500	75	RE 735 Phosphor
17	24 (610)	17036	F17T8/SP41	24	20000	1325	1190	4100	75	RE 741 Phosphor
25	36 (915)	22648	F25T8/SPX30	24	20000	2200	1980	3000	84	RE 830 Phosphor
25	36 (915)	22650	F25T8/SPX35	24	20000	2200	1980	3500	84	RE 835 Phosphor
25	36 (915)	22651	F25T8/SPX41	24	20000	2200	1980	4100	80	RE 841 Phosphor
25	36 (915)	15943	F25T8/SP30	24	20000	2125	1910	3000	75	RE 730 Phosphor
25	36 (915)	15944	F25T8/SP35	24	20000	2125	1910	3500	75	RE 735 Phosphor
25	36 (915)	15945	F25T8/SP41	24	20000	2125	1910	4100	75	RE 741 Phosphor
32	48 (1220)	22655	F32T8/SPX30	24	20000	2950	2650	3000	84	RE 830 Phosphor
32	48 (1220)	22656	F32T8/SPX35	24	20000	2950	2650	3500	84	RE 835 Phosphor
32	48 (1220)	22657	F32T8/SPX41	24	20000	2950	2650	4100	80	RE 841 Phosphor
32	48 (1220)	23460	F32T8/SPX50	24	20000	2800	2520	5000	80	RE 850 Phosphor
32	48 (1220)	15946	F32T8/SP30	24	20000	2850	2570	3000	75	RE 730 Phosphor
32	48 (1220)	15947	F32T8/SP35	24	20000	2850	2570	3500	75	RE 735 Phosphor
32	48 (1220)	15949	F32T8/SP41	24	20000	2850	2570	4100	75	RE 741 Phosphor
40	60 (1524)	22660	F40T8/SPX30	24	20000	3725	3350	3000	84	RE 830 Phosphor
40	60 (1524)	22661	F40T8/SPX35	24	20000	3725	3350	3500	84	RE 835 Phosphor
40	60 (1524)	22662	F40T8/SPX41	24	20000	3725	3350	4100	80	RE 841 Phosphor
40	60 (1524)	15950	F40T8/SP30	24	20000	3600	3240	3000	75	RE 730 Phosphor
40	60 (1524)	15951	F40T8/SP35	24	20000	3600	3240	3500	75	RE 735 Phosphor
40	60 (1524)	15952	F40T8/SP41	24	20000	3600	3240	4100	75	RE 741 Phosphor
T8	**Diameter 1" (26 mm) – Single Pin (Fa8) Base** *Fig. 2*									
59	96 (2440)	23414	F96T8/SPX30	24	15000	5950	5410	3000	84	RE 830 Phosphor
59	96 (2440)	23415	F96T8/SPX35	24	15000	5950	5410	3500	84	RE 835 Phosphor
59	96 (2440)	23416	F96T8/SPX41	24	15000	5950	5410	4100	80	RE 841 Phosphor
59	96 (2440)	23407	F96T8/SP30	24	15000	5800	5280	3000	75	RE 730 Phosphor
59	96 (2440)	23411	F96T8/SP35	24	15000	5800	5280	3500	75	RE 735 Phosphor
59	96 (2440)	23412	F96T8/SP41	24	15000	5800	5280	4100	75	RE 741 Phosphor

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Discrete Electronic

Mark V Integrated Circuit

Mark VII Controllable Integrated Circuit

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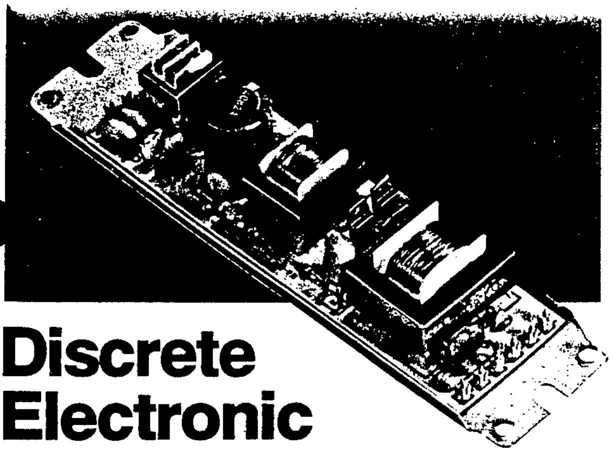
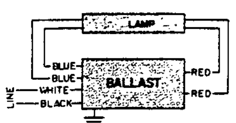


Discrete Electronic Ballasts

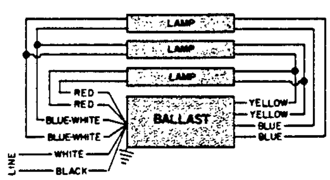
- Solid state discrete componentry assures reliable, energy saving performance.
- High frequency operation provides greatest lamp efficiencies—27% more energy efficient than conventional electromagnetic ballasts.
- Super-quiet operating sound level only 2dB above a 16dB ambient (typical).
- Run 30°C cooler than conventional electromagnetic, providing longer ballast life, saving air-conditioning costs.
- Maintains continuous heating of lamp electrodes for longest lamp life.
- Half the weight of electromagnetics.
- Input current Total Harmonic Distortion content for Rapid Start Lamps (whether rapid-started or instant-started) shall be less than 29% at maximum ballast-lamp rating (except as noted with *RH suffix).
- Input current Total Harmonic Distortion content for Slimline/Instant Start Lamps shall be less than 32%.
- Crest Factor 1.6 maximum.

Wiring Diagrams

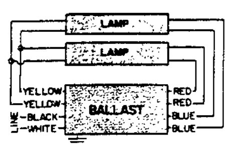
Rapid Start Lamps



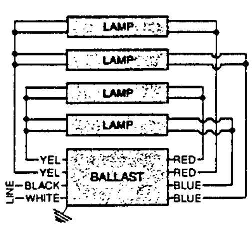
REL-1S40-TP, VEL-1S40-TP



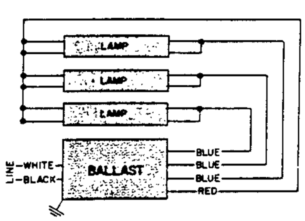
REL-3S40-TP, VEL-3S40-TP



REL-2S40-TP, VEL-2S40-TP



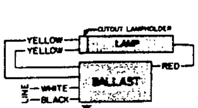
REL-4P32-TP, VEL-4P32-TP†



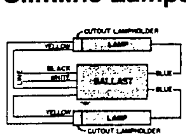
REL-3P32-TP, VEL-3P32-TP†

†For operation with fewer lamps, contact Advance.

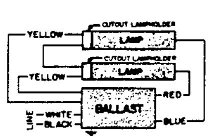
Slimline Lamps



VEL-175-S-TP



REL-2P75-S-TP



VEL-2E75-S-TP

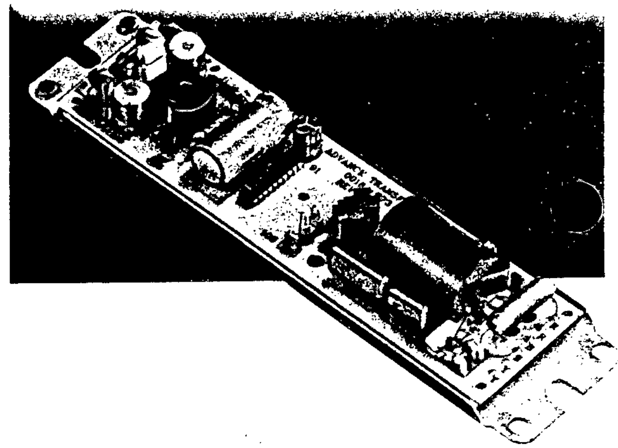
Lamp Description No.	Type	Watts	Circuit (Volts)	Catalog Number	Input Line Watts (ANSI)	Input Line Current (AMPS)	Notes
Rapid Start Lamps							
3	F17T8	17	120	REL-3P32-TP REL-3P32-RH-TP*	51	.45	Will Instant Start Rapid Start Lamps
			277	VEL-3P32-TP VEL-3P32-RH-TP*	46	.18	
4	F17T8	17	120	REL-4P32-TP REL-4P32-RH-TP*	66	.57	
			277	VEL-4P32-TP VEL-4P32-RH-TP*	61	.23	
3	F25T8	25	120	REL-3P32-TP REL-3P32-RH-TP*	70	.61	
			277	VEL-3P32-TP VEL-3P32-RH-TP*	65	.25	
4	F25T8	25	120	REL-4P32-TP REL-4P32-RH-TP*	89	.77	
			277	VEL-4P32-TP VEL-4P32-RH-TP*	85	.32	
3	F32T8	32	120	REL-3P32-TP REL-3P32-RH-TP*	89	.77	Also operate 1 or 2 F32T8 lamps
			277	VEL-3P32-TP VEL-3P32-RH-TP*	83	.31	
4	F32T8	32	120	REL-4P32-TP REL-4P32-RH-TP*	112	.97	Also operate 1, 2 or 3 F32T8 lamps
			277	VEL-4P32-TP VEL-4P32-RH-TP*	110	.41	
3	F40T8	40	120	REL-3P32-TP REL-3P32-RH-TP*	108	.93	
			277	VEL-3P32-TP VEL-3P32-RH-TP*	100	.38	
1	F40T12	34	120	REL-1S40-TPⒺ	31	.27	Also operate F30T12 25 & 30W, and F40T10 lamps
		40			36	.32	
		34	277	VEL-1S40-TPⒺ	31	.12	
		40			36	.14	
2	F40T12	34	120	REL-2S40-TPⒺ	59	.54	Also operate F30T12 25 & 30W, and F40T10 lamps
		40			71	.65	
		34	277	VEL-2S40-TPⒺ	59	.23	
		40			71	.28	
3	F40T12	34	120	REL-3S40-TP	93	.80	Also operate F30T12 25 & 30W, and F40T10 lamps
		40			109	.95	
		34	277	VEL-3S40-TP	93	.35	
		40			109	.41	
Slimline/Instant Start Lamps							
1	F96T12	60	277	VEL-175-S-TP	58	.23	Also operate F72T12
		75			73	.29	
2	F96T12	60	120	REL-2P75-S-TPⒺ	112	1.03	Also operate F72T12
		75			137	1.21	
		60	277	VEL-2E75-S-TPⒺ	113	.45	
		75			134	.51	

NOTES: Ⓔ Meets or exceeds requirements of National Energy Conservation Amendments (NAECA) of 1988. Other listed ballasts are exempt from these requirements because NAECA does not apply to these ratings.
*RH Suffix indicates ballasts maintain Total Harmonic Distortion of less than 15% at maximum ballast-lamp rating.
For detailed specification information please refer to:
Discrete Electronic Ballasts—Form No. 1539.

Dimensions

	Length	Mounting Length	Width	Height
Rapid Start	9½″	8²⁹⁄₃₂″	2⅜″	1½″
Slimline	11¾″	11⁹⁄₆₄″	3⁷⁄₆₄″	1²⁵⁄₃₂″

MARK Ⅴ Integrated Circuit Ballasts



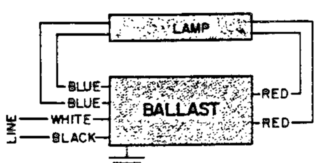
Lamp Description			Circuit (Volts)	Catalog Number	Input Line		Notes
No.	Type	Watts			Watts (ANSI)	Current (AMPS)	
Rapid Start Lamps							
1	F32T8	32	120	RIC-132-TP	31	.27	Also operate F25T8 & 40W long twin-tube lamps
			277	VIC-132-TP	31	.12	
2	F32T8	32	120	RIC-2S32-TP	61	.52	Also operate F25T8 & 40W long twin-tube lamps
			277	VIC-2S32-TP	60	.22	
3	F32T8	32	120	RIC-3S32-TP	95	.82	
			277	VDC-3S32-TP	93	.34	
1	F40T12	34	120	RIC-140-TPⒺ	31	.26	Also operate F30T12 25 & 30W, F32T8 and F40T10 lamps; and 36 & 39W long twin-tube lamps
		40			36	.30	
		34	277	VIC-140-TPⒺ	31	.11	
		40			36	.13	
2	F40T12	34	120	RIC-2S40-TPⒺ	60	.51	Also operate F30T12 25 & 30W, F32T8 and F40T10 lamps; and 36 & 39W long twin-tube lamps
		40			72	.61	
		34	277	VIC-2S40-TPⒺ	60	.22	
		40			72	.26	
3	F40T12	34	120	RIC-3S40-TP	95	.81	Also operate F30T12 25 & 30W, and F40T10 lamps; and 36 & 39W long twin-tube lamps
		40			106	.91	
		34	277	VIC-3S40-TP	93	.34	
		40			104	.38	

NOTES: Ⓔ Meets or exceeds requirements of National Energy Conservation Amendments (NAECA) of 1988. Other listed ballasts are exempt from these requirements because NAECA does not apply to these ratings.
For detailed specification information please refer to:
Mark Ⅴ IC Ballasts—Form No. 1535.

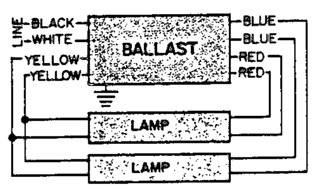
Dimensions

Length	Mounting Length	Width	Height
9½"	8²⁹⁄₃₂"	2⅜"	1½"

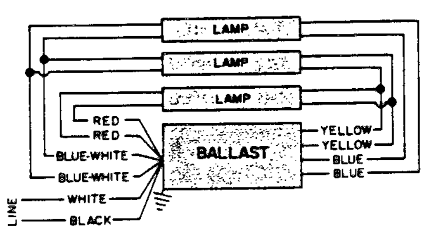
Wiring Diagrams



Single lamp ballasts



Two lamp ballasts



Three lamp ballasts

- Unique integrated circuit design incorporates a single silicon chip which controls overall ballast operation. Extensive protective circuitry assures dependability.
- Will maintain constant light output through input voltage ranges of 90 to 145 volts (120v ballast) and 200 to 320 volts (277v ballast).
- High frequency operation provides greatest lamp efficiencies—27% more energy efficient than conventional electromagnetic ballasts.
- Super-quiet operating sound level only 2dB above a 16dB ambient (typical).
- Run 30°C cooler than conventional electromagnetics, providing longer ballast life, saving air-conditioning costs.
- Maintains continuous heating of lamp electrodes for longest lamp life.
- Half the weight of electromagnetics.
- Input current Total Harmonic Distortion content shall be below 13% at maximum ballast-lamp rating.
- Crest Factor maintained below 1.4.

Mark VII Controllable Integrated Circuit Ballasts

- Internally equipped with supplementary circuits which can regulate the light output of fluorescent lamps between 20% and 100% of nominal in response to remotely activated signals.
- Combined with compatibly designed, remotely mounted manual dimming controls, ambient light sensors and occupancy/motion sensors, the Mark VII responds to their signals to provide light *in the proper amount, only when and where it is required.*
- Ballast provides its own 0–10VDC signal directly to control unit via auxiliary pair of Class 2, low voltage wiring (fully isolated from ballast input power). Requires no other intermediate trimming controls.
- Unique integrated circuit design incorporates a single silicon chip which controls overall ballast operation. Extensive protective circuitry assures dependability.
- Will maintain constant light output through input voltage ranges of 90 to 145 volts (120v ballast) and 200 to 320 volts (277v ballast).
- High frequency operation provides greatest lamp efficiencies—27% more energy efficient than conventional electromagnetic ballasts. Maximum power cost savings may be achieved in combination with remote control/sensing units.
- Super-quiet operating sound level only 2dB above a 16dB ambient (typical).
- Run 30°C cooler than conventional electromagnetics, providing longer ballast life, saving air-conditioning costs.
- Maintains continuous heating of lamp electrodes for longest lamp life.
- Half the weight of electromagnetics.
- Input current Total Harmonic Distortion content shall be below 13% (at maximum ballast-lamp rating) of full light output current levels throughout the dimming range.
- Crest Factor maintained below 1.4.

Specifications and data in this bulletin are subject to change without notice.

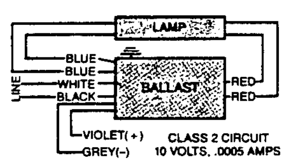
Lamp Description			Circuit (Volts)	Catalog Number	Input Line		Notes
No.	Type	Watts			Watts (ANSI)	Current (AMPS)	
Rapid Start Lamps							
1	F32T8	32	120	RDC-132-TP	31	.27	Also operate F25T8 lamps
			277	VDC-132-TP	31	.12	
2	F32T8	32	120	RDC-2S32-TP	61	.52	Also operate F25T8 lamps
			277	VDC-2S32-TP	60	.22	
3	F32T8	32	120	RDC-3S32-TP	95	.82	
			277	VDC-3S32-TP	93	.34	
1	F40T12	34	120	RDC-140-TPⓔ	31	.26	Also operate F30T12 25 & 30W, F32T8 and F40T10 lamps; and 36 & 39W long twin-tube lamps
		40			36	.30	
		34	277	VDC-140-TPⓔ	31	.11	
		40			36	.13	
2	F40T12	34	120	RDC-2S40-TPⓔ	60	.51	Also operate F30T12 25 & 30W, F32T8 and F40T10 lamps; and 36 & 39W long twin-tube lamps
		40			72	.61	
		34	277	VDC-2S40-TPⓔ	60	.22	
		40			72	.26	
3	F40T12	34	120	RDC-3S40-TP	95	.81	Also operate F30T12 25 & 30W, and F40T10 lamps; and 36 & 39W long twin-tube lamps
		40			106	.90	
		34	277	VDC-3S40-TP	93	.35	
		40			104	.38	

NOTES: ⓔ Meets or exceeds requirements of National Energy Conservation Amendments of 1988. Other listed ballasts are exempt from these requirements because NAECA does not apply to these ratings.
Mark VII ballast light output control is independent of branch circuit wiring. A control unit can operate one or multiple ballasts. Please consult control unit manufacturer's literature for details.
For detailed specification information refer to:
Mark VII CIC Ballasts—Form No. 1540.

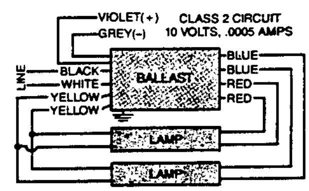
Dimensions

Length	Mounting Length	Width	Height
9½″	8²⁹⁄₃₂″	2⅜″	1½″

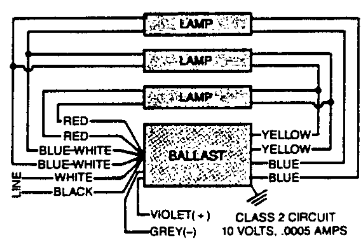
Wiring Diagrams



Single Lamp Ballasts



Two Lamp Ballasts



Three Lamp Ballasts

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HVAC CONTROLS

Programmable thermostats are available to automaticly set back the space temperature settings during unoccupied periods. The current thermostats keep the occupied temperature settings 24 hours per day. The heat pump thermostats gradually return the space temperature setting back to the occupied settings with out the use of the emergency resistance heat. The thermostat increases the temperature in increments.

The criteria used for study purposes are: a 10F temperature set back for housing and 15F set back for administration, dining, and latrines. The construction cost is about $309 per thermostat for hot water/oil fired heating systems, and $395 per thermostat for heat pump systems. The actual cost of the thermostats will vary depending on the quantity purchased and the procurement method used.

Additional information may be obtained from the following manufacturers:

HONEYWELL
1885 Douglas Drive North
Golden valley, MN 55422-4386

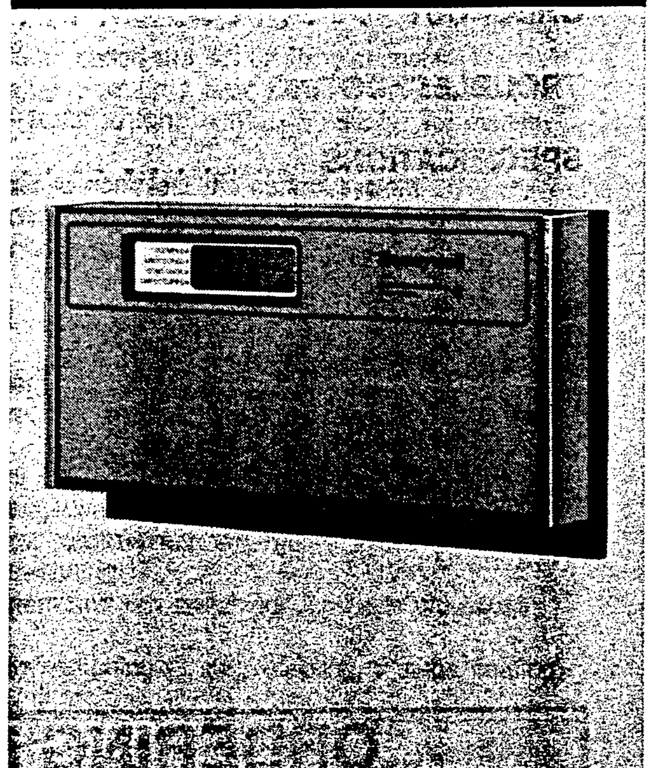
Grainger
2050 Magnoliea St.
Richmond, Virginia 23223-2340
(804) 649-0731

Honeywell

THE T7300 IS A PROGRAMMABLE THERMOSTAT FOR COMMERCIAL SINGLE ZONE HEATING, VENTILATING, AND AIR CONDITIONING (HVAC) EQUIPMENT. THE T7300 DIRECTLY REPLACES MOST SINGLE STAGE AND MULTISTAGE THERMOSTATS TO IMPROVE CONTROL, PROVIDE SIGNIFICANT ENERGY SAVINGS AND INCREASE USER CONVENIENCE.

- ☐ Seven-day flexible programming
- ☐ Full feature Liquid Crystal Display
- ☐ Proportional plus Integral (P+I) control
- ☐ Intelligent Recovery™
- ☐ Intelligent Fan™
- ☐ Concealed keyboard lockout switch and locking cover
- ☐ Automatic heat/cool changeover
- ☐ Q7300 switching subbases
- ☐ Built-in HVAC equipment protection (with minimum on and off times)
- ☐ Three-hour override of unoccupied program
- ☐ Continuous unoccupied key
- ☐ Comfort adjust feature
- ☐ Battery backup
- ☐ Optional remote sensor and override capability (with remote annunciation)
- ☐ 24 Vac, 50/60 Hz power supply

PROGRAMMABLE COMMERCIAL THERMOSTAT



T7300 AND Q7300

C.H.
Rev. 1-92

Form Number 63-4038—5

SYSTEM DESCRIPTION

The T7300 Programmable Commercial Thermostat system controls commercial single zone HVAC equipment. It consists of two components, the T7300 thermostat and a Q7300 subbase. The T7300 thermostat contains a keyboard for entering the times and temperatures, along with an LCD (Liquid Crystal Display) for reading back information. The thermostat also contains a microprocessor, which performs the calculations required to control the single zone system.

Two models of the T7300 are available, the T7300A and the T7300B. The T7300A cannot be overridden with the cover locked down. When the cover is locked down, the programming and override keys cannot be reached by the occupants, providing complete security. The T7300B contains a 3 HOUR OCCUPIED button on the cover, enabling programmed temperatures to be overridden without opening the cover. This button allows the occupants to temporarily adjust the temperature while avoiding unnecessary tampering.

NOTE: Honeywell offers a simplified model of the T7300, called the T7200 Programmable Commercial Thermostat. This thermostat can be used on 1 heat - 1 cool HVAC units that do not require all of the T7300's capabilities. Refer to form number 63-5056-1 for details on the T7200.

One of the Q7300 family of subbases is needed in order to complete the control system (see figure 1). There are seven different subbase applications; however, there are eleven T7300 and Q7300 combinations. Following are the seven subbase applications.

- **Q7300A** — Provides conventional control (gas and electric systems) without system or fan switching.
- **Q7300B** — Provides conventional control with system and fan switching.
- **Q7300C** — Provides heat pump control with system and fan switching. Includes provisions for auxiliary and emergency heat.
- **Q7300D** — Provides heat pump control with system and fan switching but uses conventional terminal designations. Compressor changeover is controlled internal to the heat pump equipment. Includes provisions for auxiliary and emergency heat.
- **Q7300E** — Provides conventional control with fan switching.
- **Q7300F** — Provides heat pump control without system and fan switching. Includes provisions for auxiliary heat.
- **Q7300G** —Provides conventional control with system switching (3 stage cooling, 1 stage heating).

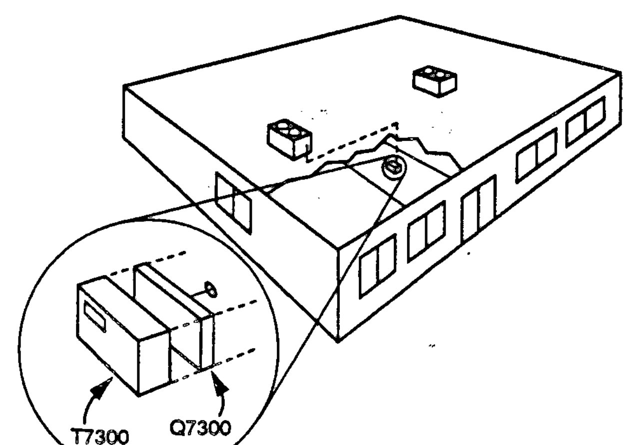


FIG. 1—T7300/Q7300 THERMOSTAT CONTROL SYSTEM CONNECTED TO A SINGLE ZONE ROOFTOP.

40

The following text describes the eleven T7300 and Q7300 combinations and the capabilities each combination offers:

1. T7300/Q7300A1000 DESCRIPTION

This system is a 1 heat - 1 cool, conventional, non-switching, auto changeover thermostat and subbase. It is considered the basic control system for the T7300/Q7300 family of thermostats and subbases. This particular T7300/Q7300 combination will provide one normally open (NO) relay contact output each for heat, cool and fan. These outputs are connected to the HVAC equipment and provide conventional temperature control with auto changeover.

This basic system includes the following standard functions:

- **Seven-day flexible programming**
  - — Two occupied and two unoccupied periods per day for each of the seven days of the week
  - — Individual setpoints for occupied heat and cool, and unoccupied heat and cool
- **Keyboard lockout switch**
- **Switch selections for device configuration**
  - — Control algorithms
    - Proportional (allows droop)
    - Proportional + integral (droopless)
  - — Sensor selection
    - Local
    - Remote
  - — Fan operation in occupied mode
    - Intermittent
    - Continuous
  - — Temperature format
    - °F
    - °C
  - — Time format
    - 12 hour
    - 24 hour
  - — Fan operation with heating
    - Energize fan in cooling only
    - Energize fan in both heating and cooling
- **Programmable display**
  - — Time
  - — Temperature
- **Three-hour override**
  - — From unoccupied to occupied
  - — User-programmed comfort adjust
- **Two status indicator LEDs**

  For use as status indication of connected equipment

2. T7300/Q7300A1018 DESCRIPTION

This system includes the following functions ***in addition to*** the basic system described in No. 1 above:

- **Selectable output staging in any of four variations**
  - — 1 heat - 1 cool
  - — 1 heat - 2 cool
  - — 2 heat - 1 cool
  - — 2 heat - 2 cool
- **Auxiliary relay output**

  Used with economizer for minimum position control based on programmed time schedule. Also can be used for switching other external equipment.

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3. T7300/Q7300B1008 DESCRIPTION

This system includes the following functions ***in addition to*** the basic system described in No. 1 above:

- **Selectable output staging in any of four variations**
  - — 1 heat - 1 cool
  - — 1 heat - 2 cool
  - — 2 heat - 1 cool
  - — 2 heat - 2 cool
- **System switching**
  - — Heat
  - — Off
  - — Cool
  - — Auto
- **Fan switching**
  - — Auto
  - — On
- **Auxiliary relay output**

  Used with economizer for minimum position control based on programmed time schedule. Also can be used for switching other external equipment.

4. T7300/Q7300C1006 DESCRIPTION

This system includes the following functions ***in addition to*** the basic system described in No. 1 above:

- **Normally open relay contacts for use in environmental control of heat pump system with a single stage compressor and auxiliary heat.**
- **System switching**
  - — Emergency heat
  - — Heat
  - — Off
  - — Cool
  - — Auto
- **Fan switching**
  - — Auto
  - — On
- **Auxiliary relay output**

  Used with economizer for minimum position control based on programmed time schedule. Also can be used for switching other external equipment.
- **Additional status indication LEDs**
  - — Emergency heat LED
  - — Auxiliary heat LED

5. T7300/Q7300C1014 DESCRIPTION

This system includes the following functions ***in addition to*** the basic system described in No. 1 above:

- **Normally open relay contacts for use in environmental control of heat pump system with a <u>two-stage compressor</u> and auxiliary heat.**
- **System switching**
  - — Emergency heat
  - — Heat
  - — Off
  - — Cool
  - — Auto
- **Fan switching**
  - — Auto
  - — On
- **Auxiliary relay output**

  Used with economizer for minimum position control based on programmed time schedule. Also can be used for switching other external equipment.
- **Additional status indication LEDs**
  - — Emergency heat LED
  - — Auxiliary heat LED

6. T7300/Q7300D1053 DESCRIPTION

This system includes the following functions ***in addition to*** the basic system described in No. 1 above:

- **Normally open relay contacts for use in environmental control of heat pump systems with a <u>single stage compressor</u>. Uses conventional terminal designations. Compressor changeover is controlled internal to the heat pump equipment.**
  - — Y1 terminal for cooling compressor control
  - — W1 terminal for heating compressor control
  - — W3 terminal for auxiliary heat control
- **System switching**
  - — Emergency heat
  - — Heat
  - — Off
  - — Cool
  - — Auto
- **Fan switching**
  - — Auto
  - — On
- **Auxiliary relay output**

  Used with economizer for minimum position control based on programmed time schedule. Also can be used for switching other external equipment.

7. T7300/Q7300D1038 DESCRIPTION

This system includes the following functions ***in addition to*** the basic system described in No. 1 above:

- **Normally open relay contacts for use in environmental control of heat pump systems with a two-stage compressor. Uses conventional terminal designations. Compressor changeover is controlled internal to the heat pump equipment.**
  - — Y1 and Y2 terminals for cooling compressor control
  - — W1 and W2 terminals for heating compressor control
  - — W3 terminal for auxiliary heat control
- **System switching**
  - — Emergency heat
  - — Heat
  - — Off
  - — Cool
  - — Auto
- **Fan switching**
  - — Auto
  - — On
- **Auxiliary relay output**

  Used with economizer for minimum position control based on programmed time schedule. Also can be used for switching other external equipment.

8. T7300/Q7300E1001 DESCRIPTION

This system includes the following functions ***in addition to*** the basic system described in No. 1 above:

- **Selectable output staging in any of four variations**
  - — 1 heat - 1 cool
  - — 1 heat - 2 cool
  - — 2 heat - 1 cool
  - — 2 heat - 2 cool
- **Fan switching**
  - — Auto
  - — On
- **Auxiliary relay output**

  Used with economizer for minimum position control based on programmed time schedule. Also can be used for switching other external equipment.

9. T7300/Q7300F1009 DESCRIPTION

This system includes the following functions ***in addition to*** the basic system described in No. 1 above:

- **Normally open relay contacts for use in environmental control of heat pump system with a single stage compressor and auxiliary heat.**
- **Auxiliary relay output**

  Used with economizer for minimum position control based on programmed time schedule. Also can be used for switching other external equipment.
- **Additional status indication LED**

  Auxiliary heat LED

10. T7300/Q7300F1017 DESCRIPTION

This system includes the following functions ***in addition to*** the basic system described in No. 1 above:

- **Normally open relay contacts for use in environmental control of heat pump system with a two-stage compressor and auxiliary heat.**
- **Auxiliary relay output**

  Used with economizer for minimum position control based on programmed time schedule. Also can be used for switching other external equipment.
- **Additional status indication LED**

  Auxiliary heat LED

11. T7300/Q7300G1007 DESCRIPTION

This system includes the following functions ***in addition to*** the basic system described in No. 1 above:

- **Fixed output staging of 3 cool, 1 heat.**
- **System switch**
  - — Heat
  - — Off
  - — Cool
  - — Auto
- **Auxiliary relay output**

  Used with economizer for minimum position control based on programmed time schedule. Also can be used for switching other external equipment.

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OPERATION

THE T7300 AND CONVENTIONAL THERMOSTATS

P + I CONTROL

The T7300's microprocessor-based control requires the user to have a new understanding of temperature control and thermostat performance. A conventional electromechanical or electronic thermostat does not control temperature precisely at setpoint. Typically, there is an offset (droop) in the control point as system load changes. This is a phenomenon that most people in the industry know and accept. Many factors contribute to offset, including switch differential, thermal lag, overshoot, cycle rates and system load.

The T7300's microprocessor simultaneously gathers, compares and computes data. Using this data, it controls a wide variety of functions. The special proprietary algorithm (program) in the T7300 virtually eliminates the factors causing offset. This improvement makes temperature control with the T7300 more accurate than with conventional electromechanical or electronic thermostats. The T7300's special temperature control algorithm is called proportional plus integral (P+I) control.

The T7300's sensor (either on board the T7300 or remote) senses the current space temperature. The T7300 compares the sensed temperature to the programmed setpoint and determines the deviation from setpoint. This deviation is known as proportional error. In addition to proportional error, the T7300 also determines a deviation based on the length of error time. This deviation is known as integral error. The sum of the two errors is the proportional plus integral (P+I) error.

The P+I computation is the major difference between most electronic thermostats and Honeywell's microprocessor-based T7300 control system. Many electronic and electromechanical thermostats take into account proportional error; however, Honeywell's microprocessor-based T7300 control system also takes into account the integral error. With the above information, the T7300's microprocessor computes the cycling rates necessary to reach and maintain the programmed temperature setpoints (refer to figure 2).

While the T7300 is designed to eliminate droop, allowing droop can be desirable in applications where building visitors are dressed for the weather and their stays are brief. Examples of these applications include fast food restaurants and convenience stores. The droopless feature of the T7300 may be overridden by placing the droop/droopless select switch located on the subbase in the OFF position. This will remove the integral calculation from the T7300 control scheme, allowing only the proportional control to occur.

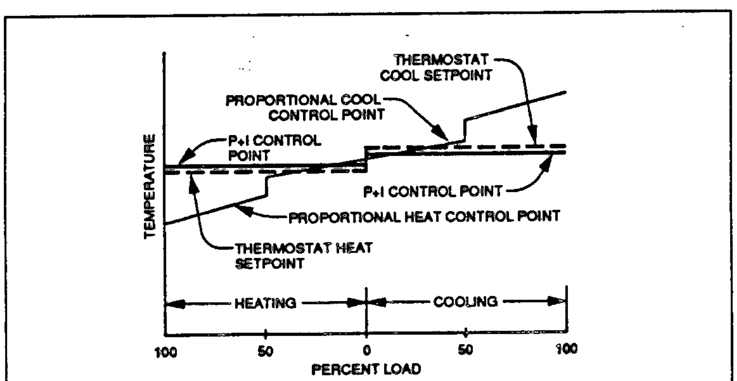

FIG. 2—PROPORTIONAL TEMPERATURE CONTROL VS. P+I TEMPERATURE. CONTROL

EQUIPMENT PROTECTION

As part of the operational sequence, the T7300 microprocessor also incorporates minimum on and off times for all heating and cooling stages. Minimum on and off times ensure that rapid cycling of equipment will not occur, extending equipment life. Minimum on/off times for compressor stages are ON - 2 minutes, OFF - 4 minutes. Minimum on/off times for heat (electric resistive or gas) are ON - 2 minutes, OFF - 2 minutes.

T7300 THERMOSTAT OPERATION

STARTUP

When power to the thermostat is turned on, a startup and initialization program begins. This startup takes place after any total loss of power (24 Vac and battery backup). At this time, the system default values are put into memory (replacing the user program that was lost). Default values are heating 68°F [20°C] and cooling 78°F [26°C] for the occupied mode. Unoccupied default values are heating 55°F [13°C] and cooling 90°F [32°C].

NOTE: These unoccupied defaults are only used if an unoccupied start time is entered or the CONT UNOC key is pressed. Immediately following initialization, the user can enter new setpoints to be used in place of the default values.

If the battery backup was operating during a power failure, and 24 Vac power comes back on, the user-entered time and temperature program saved in memory will be used. If 24 Vac power is lost, and no battery backup exists, the default temperatures will be placed into memory when the power comes back on. These default values will then be used for temperature control.

OCCUPIED

When the thermostat is operating in the occupied mode, the temperature will be controlled to the occupied heat or cool setpoints. The normally open (A1) auxiliary relay contacts will be closed and the normally closed (A3) auxiliary relay contacts will be opened during the occupied mode (if the subbase being used has this option). The fan will operate as follows:

No Switching Subbase Used: Operation of the fan will be continuous (fan always energized) unless the fan option switch on the back of the T7300 (switch No. 3) is set to intermittent (cycles with Y1 or W1).

Switching Subbase Used: The Q7300 fan switch can be set to ON (always energized) or AUTO (cycles with Y1 or W1).

NOTE: If subbase configuration switch No. 4 (on any Q7300 conventional subbase) is set to the ON position, the fan cycles on a call for cooling only; switch No. 4 has no effect on heat pump subbases (Q7300C, D, F).

UNOCCUPIED

When the thermostat is operating in the unoccupied mode, the temperature will be controlled to the unoccupied heat or cool setpoints. The auxiliary relay contacts will be open and the fan will operate as follows:

Switching or Non-Switching Subbase Used: The fan will always be intermittent (cycles with Y1 or W1).

NOTE: If subbase configuration switch No. 4 (on any Q7300 conventional subbase) is set to the ON position, the fan cycles on a call for cooling only; switch No. 4 has no effect on heat pump subbases (Q7300C, D, F).

RECOVERY FROM UNOCCUPIED (CONVENTIONAL SYSTEM)

The T7300 employs Intelligent Recovery™, a unique recovery algorithm that attempts to reach setpoint at the programmed occupied start times. Intelligent Recovery™ is a setpoint ramping feature that is used when a programmed change from unoccupied setpoints to occupied setpoints occurs. This feature selects the optimum time to begin building warm-up or cool-down and can vary depending on space temperature deviation from setpoint. The end result of Intelligent Recovery™ is

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the correct temperature at occupancy time. This feature increases energy savings and user convenience.

For example, look at figure 3. This figure shows heating with a conventional HVAC system. The occupied start time is 7:00 a.m. and the occupied heat setpoint is 72°F. The unoccupied heat setpoint is 60°F, the current time is 4:00 a.m. and the T7300 has been controlling the space temperature (currently 60°F) to the unoccupied heat setpoint. The T7300 uses a 5°F per hour recovery ramp rate. Additional stages of heating will be energized only if the recovery ramp rate is not being met. In this example, the minimum start time will be two hours, 20 minutes (12°F divided by 5°F per hour). Therefore, heating will start at 4:40 a.m. and continue until the occupied setpoint is reached.

In the next example (see figure 4), the start times and setpoints are the same as the previous example; however, space temperature at 4:00 a.m. is 65°F. No heating has been used to maintain this temperature due to the heat load of the building. In this example, the T7300 will still ramp the setpoint as in the above example but heating will not be energized until the ramped setpoint is greater than the space temperature. Therefore, heating will be energized to start recovery at 5:40 a.m., and the setpoint will continue to ramp up at a rate of 5°F per hour until the occupied setpoint is reached.

The above examples also apply in cooling. However, the setpoint will ramp down from the unoccupied cool setpoint and decrease until the occupied cool setpoint is reached. The ramp rate will be 5°F per hour. The auxiliary relay contacts will remain open (de-energized) during recovery, and the fan will be cycled with Y1 or W1.

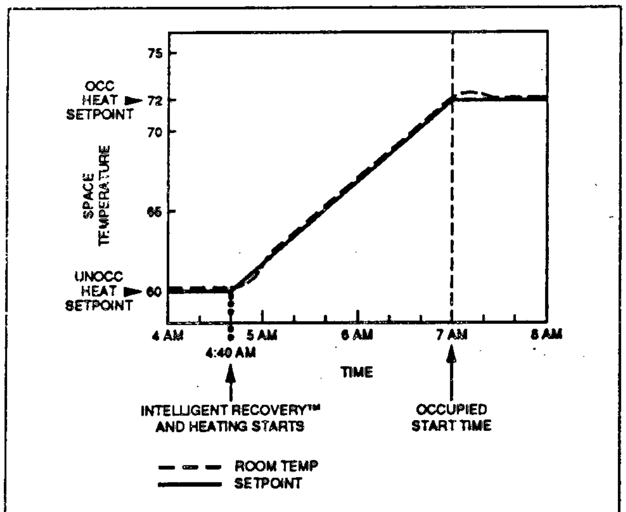

FIG. 3—RECOVERY EXAMPLE; ROOM TEMPERATURE AT UNOCCUPIED SETPOINT.

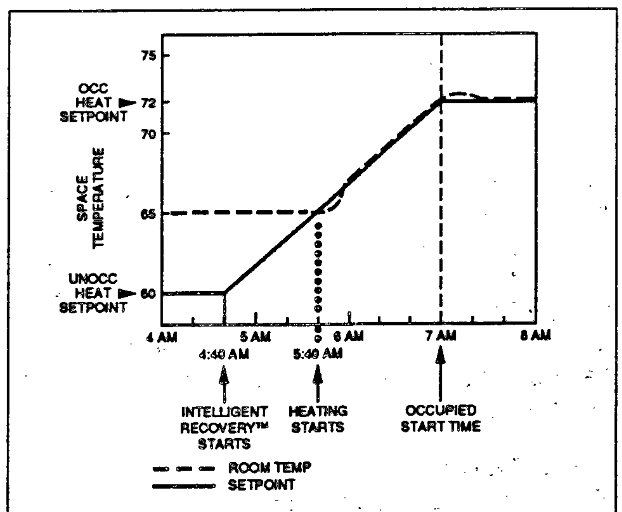

FIG. 4—RECOVERY EXAMPLE; ROOM TEMPERATURE AT 65°F.

HEAT PUMP OPERATION

A T7300 may be configured for either heat pump or conventional control. When the T7300 is configured for heat pumps, some additional information is required.

The heat pump jumper (located on the back of the T7300), will place the thermostat into the heat pump mode. Refer to the INSTALLATION section.

O AND B TERMINALS FOR HEATING OR COOLING CHANGEOVER

NOTE: Q7300D subbases do not provide heat pump changeover control, so this section on the O and B terminals does not apply. The Q7300D subbase is used in heat pump applications when reversing valve changeover is internal to the heat pump.

TABLE 1—OPERATION OF THE SUBBASE O AND B TERMINALS.

Q7300 Subbase System Setting	O	B
Heat	Off	On
Cool	On	Off
Auto (Heat) △1	Off	On
Auto (Cool) △1	On	Off
Emergency Heat	Off	On
Off	△2	△2

Off = Open
On = Closed

NOTE 1 : Operation of the O and B terminals in the AUTO mode depends on the current status of energized stages. If the thermostat is currently calling for heat or the system is de-energized and last call was for heating, the O and B terminals will be in the auto (heat) position as above. If the thermostat is currently calling for cooling or the system is de-energized and the last call was for cooling, the O and B terminals will be in the auto (cool) position as above. Operation of the O and B terminals on the Q7300F subbases functions in the same way.

NOTE 2 : Operation of the O and B terminals in the OFF mode depends on whether the last call was for heating or cooling. If the last call was for heating, the O and B terminals will be in the auto (heat) position as above. If the last call was for cooling, the O and B terminals will be in the auto (cool) position as above.

RECOVERY FROM UNOCCUPIED (HEAT PUMP OPERATION)

Recovery from unoccupied differs from the conventional application mentioned earlier with respect to the ramp rate used for recovery during heating. With heat pump selected, the heating recovery ramp rate will be 3°F per hour. In the previous recovery example (figure 3), the recovery ramp rate was 5°F per hour. If this 5°F per hour is changed to 3°F per hour, the recovery time calculated by the thermostat will be four hours. Therefore, the startup of heating for recovery in figure 3 would have been 3:00 a.m. for a heat pump. The cooling ramp rate does not differ when heatpump is selected and will remain at 5°F per hour.

FAN OPERATION

The fan will be energized continuously in the occupied mode if the subbase's fan switch is in the ON position or it will be energized intermittently if the switch is in the AUTO position. During unoccupied mode, the fan will cycle with Y1 and W1 if the subbase is a Q7300D. The Q7300 subbase switch No. 4 has no effect when the thermostat is configured for heatpump operation.

EMERGENCY HEAT

On heat pump subbases that provide system switching, when the subbase's system switch is placed into the emergency heat position, auxiliary heat (W1 on Q7300C models, W3 on Q7300D models) will be treated as stage 1. The compressor stages (Y1/Y2, if available, and W1/W2 on Q7300D models) will be locked off, and the fan will cycle with auxiliary heat.

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GENERAL OPERATIONAL INFORMATION

CYCLE RATES

The T7300's control algorithm maintains temperature by cycling stages of heating or cooling to meet setpoint demand. The following nominal cycle rates are provided:

System Type	H1	H2	C1	C2	C3
Conventional	8	8	4	4	4
Heat Pump	4	8	4	4	—

SUBBASE AUXILIARY RELAY

The Q7300's auxiliary relay output acts as a time-of-day switch to be used with an economizer's minimum position control. The normally open (A1) auxiliary relay contacts are closed during the occupied period and open during the unoccupied period. The normally closed (A3) auxiliary relay contacts are open during the occupied period and closed during the unnoccupied period. During recovery, the contacts will remain in their normal state.

INTERFACING WITH ELECTROMECHANICAL ECONOMIZERS (SUBBASES WITH AUXILIARY RELAY)

Mechanical cooling is often used when outside temperatures are in the 50s or 60s and humidity is below 50 percent. In central and northern climates, hundreds of hours fall into this temperature category. By permitting 80 to 100 percent outside air into the system, mechanical cooling may not be needed at all, particularly during the spring and fall.

The HVAC system can take advantage of this outside air with the use of an economizer. The typical economizer consists of an outside air damper and a motor controlling the dampers. Also, an outdoor air changeover control is used to determine when outdoor air is suitable for cooling. A minimum position potentiometer is used for adjusting the minimum position of the economizer dampers. These adjustments provide a minimum amount of fresh air for ventilation.

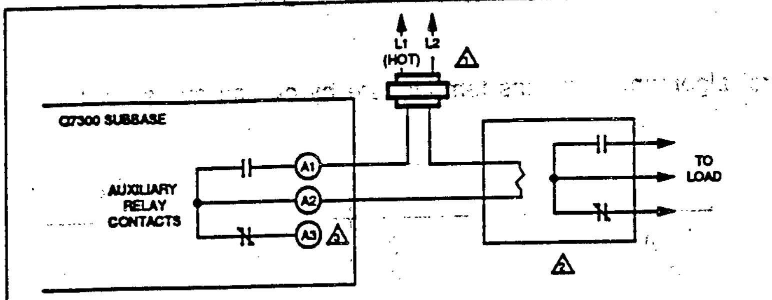
Two benefits are realized when an economizer is used. When the economizer is in operation, compressor run time is reduced, thereby saving energy and extending the life of the compressor. However, there is a drawback. During the unoccupied period, if there is no call for cooling or outdoor air is not suitable for free cooling, the economizer is controlled to minimum position. This position allows some percentage of outdoor air to enter the building, regardless of the air suitability. In many cases, this situation will cause the heating or cooling to run more often than it would if suitable outdoor air was permitted to enter the building during the unoccupied period.

The T7300 can take advantage of an economizer, if it is available, by connecting the auxiliary relay contacts (A1 and A2) of the Q7300 subbase to control the economizer's minimum position potentiometer. These contacts close during the occupied period, allowing the economizer to operate normally.

During the unoccupied period, these contacts will be open, disabling the minimum position feature of the economizer. If the economizer calls for minimum position during its operation and the unoccupied period is in affect, the open contacts cause the economizer to drive fully closed instead of staying open at minimum position. This condition reduces the possibility of undesirable outdoor air from entering the building, reducing the internal load on the HVAC system and saving additional energy.

OTHER USES FOR THE AUXILIARY RELAY

The auxiliary relay may be used with other building loads that require some type of control based on the occupied and unoccupied start times rather than the economizer. Hot water heaters, lighting or baseboard heat are just a few examples of the additional loads that may be connected to the auxiliary relay contacts of the Q7300 subbase. The Q7300 auxiliary relay contacts are rated for 1.6A at 30 Vac. The use of an external relay and transformer, as shown in figure 5, can also be adapted to higher current applications.



POWER SUPPLY. PROVIDE DISCONNECT MEANS AND OVERLOAD PROTECTION AS REQUIRED. 24 VAC SECONDARY.

RELAY REQUIRED (R8222 OR SIMILAR).

TERMINAL A3 AVAILABLE ON Q7300A, B, D, E AND G MODELS ONLY.

FIG. 5—USE OF EXTERNAL RELAY AND TRANSFORMER FOR AUXILIARY LOADS GREATER THAN 1.6 A.

DUTY CYCLE INTERFACE

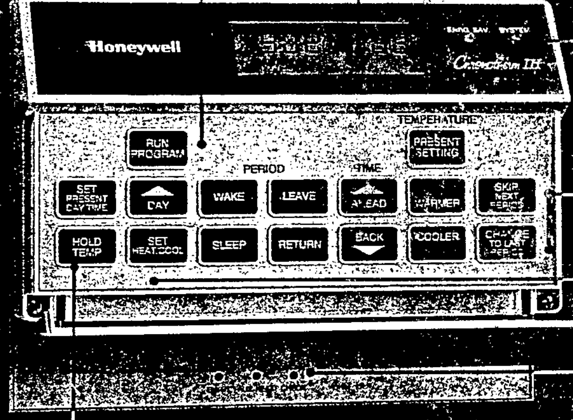
Duty cycling HVAC equipment controlled with a T7300 is not recommended since the T7300 is already maintaining an optimum control cycle rate. Imposing an additional external duty cycle will only increase the proportional plus integral error being sensed by the T7300, which results in a significant degradation of temperature control and equipment efficiency.

Honeywell

The Perfect Choice for Heat Pump Systems

T8611 Chronotherm III™ Heat Pump Thermostat

The Perfect Choice *because it maximizes comfort while saving energy.*



Shown in Premier White

- Press and everything runs according to program.
- Shows more than time and temperature at-a-glance. Tells you what day and program you're in.
- Status lights allow you to see if the equipment is on and if the thermostat is in an energy saving mode.
- Automatic changeover between heating and cooling available in some models.
- You can easily modify or override a program if you're away, home sick or stay up late.
- Set both heating and cooling programs at one time. No need to reprogram when changing from heating to cooling.
- LED status lights tell when emergency heat, auxiliary heat or if equipment malfunction is occurring.
- Hold a set temperature for vacations or long holidays.
- This versatile thermostat can be used on virtually all water to air, air to air split systems and unitary multistage heat pumps.
- Comes with the easiest-to-use programming manual ever written for an energy saving thermostat.
- Set different schedules for weekdays, Saturday and Sunday or for every day of the week. Depending on the model you choose.
- WARMER, COOLER keys allow one-button override of current temperature to increase comfort.
- Batteries can be changed without losing the program.
- "Arm chair" programming convenience allows you to remove the thermostat from the wall to program it.
- One key. One function. Each key does only what it says.

Comfort

Perfect because the thermostat *automatically* operates your heating and cooling system according to your schedule. You wake up warm on a cold winter morning and step into a cool home on a sweltering day.

The smart thermostat that:

- calculates when the heating or cooling system will go on to have the house at the desired temperature by the time you wake up.
- remembers to change the heating or cooling setting when you leave home.
- calculates when to start heating or cooling so it's comfortable by the time you get home.
- automatically changes the temperature setting to the energy-saving temperature at bedtime.

Optimum Energy Savings

Adaptive Intelligent Recovery™ maximizes energy savings. The thermostat chooses the optimum time to start gradually returning to the next comfort temperature setting. You save energy for a longer period of time yet you're comfortable when you want to be. It will save up to 40% on your energy costs. And, because it's Honeywell, you'll enjoy even temperature and comfort . . . no matter what the weather is like outside. Best of all, the Chronotherm III Thermostat usually pays for itself in energy savings in two years or less!

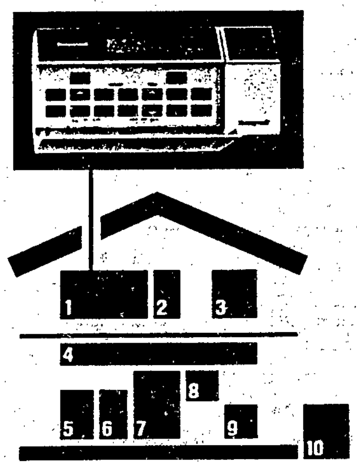
Convenience

The Chronotherm III Thermostat comes already programmed for nighttime energy savings. And, you can easily set it to fit your own energy saving schedule . . . up to four different heating/cooling time periods (WAKE, LEAVE, RETURN and SLEEP) in each daily schedule.

Chronotherm III Thermostats offer more features than other thermostats, yet you will find they are the easiest-to-use. Because more "human factors" were designed into the product than ever before.

Total Indoor Comfort

The Chronotherm III Thermostat is a key component of the Perfect Climate System. The Perfect Climate System provides total indoor comfort. It makes you feel better; allows you to live and work in a more comfortable environment; achieves maximum energy savings and maintains precise control over indoor temperature and humidity.

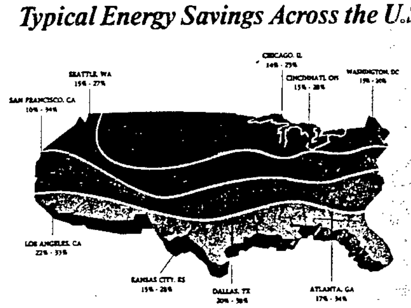


1. **Honeywell Chronotherm III Thermostat**
2. **Honeywell W8600 Air Cleaner Performance Indicator**
3. Honeywell Humidistat
4. Honeywell/Trol-A-Temp Zoning System
5. Honeywell Energy Recovery Ventilator
6. Honeywell Electronic Air Cleaner
7. Optimal-Efficiency Heating System
8. Humidifier
9. Honeywell Water Filter
10. Optimal-Efficiency Heat Pump or Air Conditioner

PERFECT CLIMATE™

For More Information To learn more about a Perfect Climate System, write for our 36-page Perfect Climate Brochure. Send $2.00 check or money order to cover postage and handling to Perfect Climate Department, Honeywell Customer Assistance Center, MN12-4118, Honeywell Plaza, Minneapolis, MN 55408. Or contact your Honeywell dealer.

Typical Energy Savings Across the U.S.*



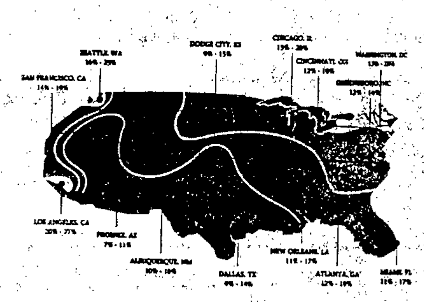
Percent of Heating Energy You Can Save

10°** Single Heating Setback 70° to 60° 8 Hrs./Day	10°** Double Heating Setback 70° to 60° 8 Hrs./Day, 8 Hrs./Nite
10% to 13%	17% to 21%
14% to 15%	22% to 29%
16% to 18%	30% to 35%
19% to 23%	Up to 40%

(Based on the Average Home)

**Actual savings depend on your home, geographic location, number of temperature changes and amount of degrees changed.*

***Savings for a 5° heating setback are at least ½ of savings for a 10° setback.*



Percent of Cooling Energy You Can Save

5° Single Cooling Setup 75° to 80° 8 Hrs./Day	5° Double Cooling Setup 75° to 80° 9 Hrs./Day, 7 Hrs./Nite
7% to 9%	11% to 15%
10% to 11%	16% to 18%
12% to 14%	19% to 22%
15% to 18%	23% to 33%

(Based on the Average Home)

Honeywell

Helping You Control Your World

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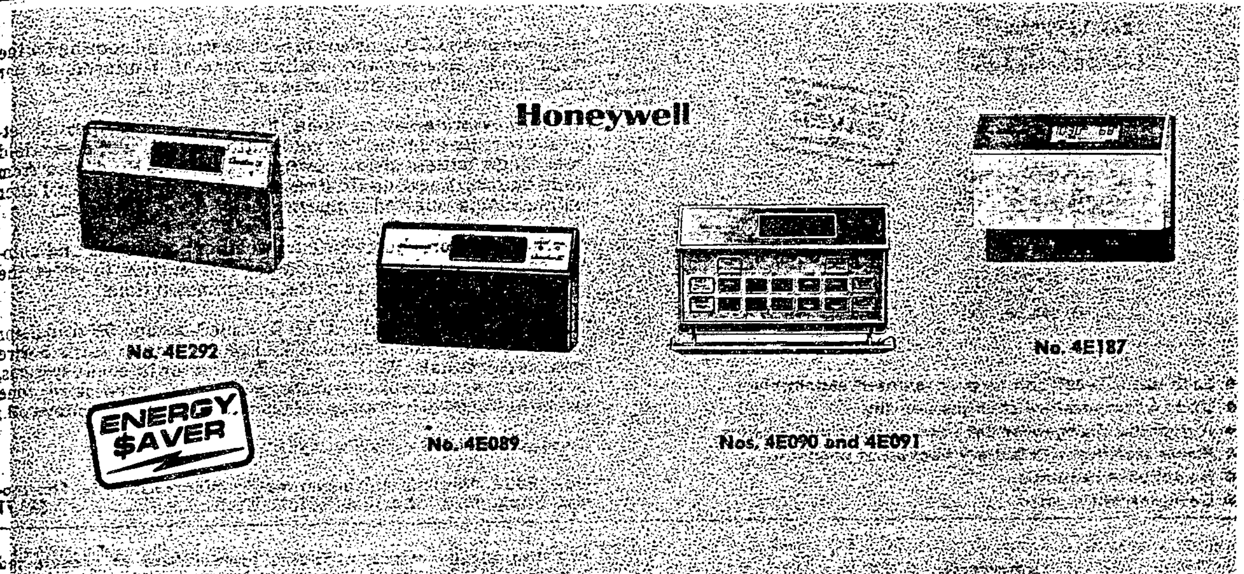
HONEYWELL PROGRAMMABLE MICROELECTRONIC THERMOSTATS



Features:

- **Automatically raise or lower temperature at preselected times**
- **LCD continuously indicates time-of-day, day of week, current program period and room temperature**
- **Temporary program override available by using "Warmer" and "Cooler" keys, "Skip next Period", or "Change to Last Period" key**
- **"Hold Temp" key provides indefinite program override for vacations and holidays**
- **Adaptive Intelligent Recovery™ assures that desired temperature is met at programmed time, maximizing comfort and energy savings**
- **No subbase required**

TEMPERATURE RANGE: 45-88°F

ELECTRICAL RATINGS: 15-30VAC. No. 4E292 is 1.6 amps max. Nos. 4E089-4E187 are 1.2 amps max.

THERMOSTAT SPECIFICATIONS DATA

Switching System	Fan	Stock No.	Application	Power Method	Battery Backup	Dual Transformer Compatible	Temp. Setting per Day	Programs per Week	Stages Heat	Stages Cool
Heat-Off-Cool	On-Auto	4E292	Gas, oil, electric 24V, millivolt and single stage heat pump	Battery	—	Yes	4	3*	1	1
Heat-Off-Cool	On-Auto	4E089	Gas, oil or electric 24V systems with independantly controlled fan in heat and single stage heat pump	24V	Yes	No	4	3*	1	1
Heat-Of-Cool	On-Auto	4E090	Gas, oil or electric 24V systems with independently controlled fan in heat	24V	Yes	Yes	4	3*	1	1
Heat-Off-Cool-Auto	On-Auto	4E091		24V	Yes	Yes	4	3*	1	1
Heat-Off-Cool-Auto	On-Auto	4E187		24V	Yes	Yes	4	7	1	1

(*) One program for weekdays. Separate programs for Saturday and Sunday.

THERMOSTAT ORDERING DATA

Type of Thermostat	Battery Included	Dimensions (Inches) H	W	D	Honeywell Model	Stock No.	List	Each	Shpg. Wt.
Heating-Cooling	Yes	4 1/16	7	1 3/4	T8602C1046	**4E292**	$250.59	**$131.47**	1.3
Heating-Cooling	Yes	4 1/16	7	1 3/4	T8600C1006	**4E089**	254.10	**134.67**	1.4
Heating-Cooling	Yes	4 1/16	7	1 3/4	T8600C1014	**4E090**	260.15	**137.88**	1.2
Heating-Cooling	Yes	4 1/16	7	1 3/4	T8600D1004	**4E091**	293.42	**155.51**	1.4
Heating-Cooling	Yes	4 1/16	7	1 3/4	T8621A7002	**4E187**	320.40	**172.24**	1.4

THERMOSTAT GUARD FOR HONEYWELL THERMOSTATS ABOVE

Thermostat Guard is a locking cover for Honeywell thermostats 4E089, 4E090, 4E091, 4E187, 4E188, and 4E292. Covers yet keeps visible time and temperature display, and programming keys. Maintains access to WARMER/COOLER keys. Displays LED lights on those thermostats which have LED lights. Beige plastic with removable metal faceplate; lock with key. 4⅞H x 1⅜W x 7⅛"D. Honeywell brand (TG586A1000).

No. 4E293. Thermostat Guard. Shpg. wt. 0.5 lbs. List . . . .$57.08. Each **$30.18**

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